Reducing Damage from Localized Flooding

A Guide for Communities

FEMA 511 / June 2005

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Acknowledgements

This guide was produced with the assistance and expert advice of numerous specialists throughout the United States. Thanks are extended to the technical reviewers, and to the local, State, and Federal officials who provided valuable input through interviews with project staff.

Mike Buchert, City of Tulsa, Oklahoma, Public Works

Dave Canaan, Director of Charlotte/Mecklenburg County, North Carolina, Stormwater Services

Dr. Mow-Soung Cheng, Department of Environmental Resources, Prince George's County, Maryland

Jack DeCicco, State Farm Insurance Company

Ted DeBaene, Owen and White, Inc., Baton Rouge, Louisiana

Trudi Johnson, CRS Coordinator, Hilton Head Island, South Carolina

Ward Miller, Lake County, Illinois, Stormwater Management Commission

Doug Plasencia, AMEC Earth & Environmental, Inc., Phoenix, Arizona

Andy Reese, AMEC Earth & Environmental, Inc., Nashville, Tennessee

Joe Tram, Maricopa County Flood Control District, Arizona

Kevin Stewart, Urban Drainage and Flood Control District, Denver, Colorado

Tom Donaldson, National Weather Service, Silver Spring, Maryland

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This guide was prepared by URS Corporation, French & Associates, Ltd., and JLM Associates, Inc. under Task Order 269 of the FEMA Hazard Mitigation Technical Assistance Program.

Terminology

Throughout this guide, the following terms are used.

A Zone is defined as the Special Flood Hazard Area shown on a community's Flood Insurance Rate Map. The A Zone is the area subject to inundation during a 100-year flood, which is the flood elevation that has a 1-percent chance of being equaled or exceeded each year. There are several categories of A Zones, including AO (shallow sheet flow or ponding; average flood depths are shown); AH Zones (shallow flooding; base flood elevations are shown); numbered A and AE Zones (base flood elevations are shown); and unnumbered A Zones (no base flood elevations are provided because detailed hydraulic analyses were not performed).

B Zone is defined as an area of moderate flood hazard, usually depicted on Flood Insurance Rate Maps as between the limits of the base flood and 500-year flood of the primary source of flooding. B Zones may have local, shallow flooding problems. B Zones are also used to designate areas protected by levees and base floodplains of little hazard, such as those with average flood depths of less than 1 foot.

BFE is the base flood elevation. The base flood is the flood having a 1-percent chance of being equaled or exceeded in any given year. (It is also known as the 100-year flood.) The BFE has been adopted by the National Flood Insurance Program as the basis for mapping, insurance rating, and regulating new construction.

C Zone is defined as an area of minimal flood hazard, usually depicted on the Flood Insurance Rate Map as above the 500-year flood level of the primary source of flooding. C Zones tend to have local, shallow flooding problems. B and C Zones may have flooding that does not meet the criteria to be mapped as a Special Flood Hazard Area, especially ponding, localized drainage problems, and streams that drain smaller watersheds.

CRS is the abbreviation for Community Rating System, a voluntary program for National Flood Insurance Program-participating communities. The goals of the CRS are to reduce flood losses, facilitate accurate insurance rating, and promote the awareness of flood insurance. The CRS was developed to provide incentives for communities to go beyond the minimum floodplain management requirements to

develop extra measures to protect them from flooding. The incentives are in the form of premium discounts.

Community means any city, village, town, county, or other local government with authority to enact floodplain management measures.

DFE is the acronym for design flood elevation, the specified level to which a structure will be protected from floods when it is built or retrofitted.

FEMA is the Federal Emergency Management Agency, the Emergency Preparedness and Response Directorate within the U.S. Department of Homeland Security.

FIRM is the acronym for the Flood Insurance Rate Map, an official map approved by the Federal Emergency Management Agency and adopted by the community that delineates the Special Flood Hazard Area subject to the community's floodplain management regulations and the insurance risk premium zones.

Floodplain is used in a general sense to mean the area most prone to flooding, mapped or not. The floodplain for a localized flood problem may not be mapped as Special Flood Hazard Area on the Flood Insurance Rate Map.

Floodway means the stream channel and that portion of the adjacent floodplain that must remain open to permit passage of the base flood. The floodway is delineated on the Flood Insurance Rate Map or an accompanying Floodway Map and is subject to special development restrictions.

Localized flooding refers to smaller scale flooding that can occur anywhere in a community. This can include flooding in B, C, and X Zones as depicted on the Flood Insurance Rate Map. The term is also used to refer to shallow flooding that occurs in low-lying areas after a heavy rain, flooding in small watersheds, ponding, and localized stormwater and drainage problems anywhere in the community. In this guide, "local flooding" and "localized flooding" are used interchangeably.

NFIP is the National Flood Insurance Program.

Repetitive loss refers to an NFIP-insured property where two or more claim payments of more than $1,000 have been paid within a 10-year period since 1978. About 20 to 25 percent of repetitive loss properties are rated as being in B, C, or X Zones.

SFHA is the Special Flood Hazard Area, or the A and V Zones as depicted on the Flood Insurance Rate Map. B, C, and X Zones are outside of the SFHA.

Watershed means an area of any size that drains into a lake, stream, or other body of water; also known as "basin" or "catchment area."

X Zone relates to newer Flood Insurance Rate Maps, which show B and C Zones (see above) as X Zone. The shaded X Zone corresponds to a B Zone and the unshaded X Zone corresponds to a C Zone.

Part I

Introduction

This guide is intended to help local offices in cities, towns, villages, and counties in the United States understand what they can do to reduce the damage, disruption, and public and private costs that result from the shallow, localized flooding that occurs within their jurisdictions. This is flooding that all too often escapes the attention received by larger floods or those that are clearly mapped and subject to floodplain development regulations.

Part I of the document introduces the content and goals of the guide. It includes Chapters 1 and 2, which:

- Outline the purpose of the guide and how to use it;
- Explain what is meant by local or localized flooding;
- Lay out the scope of the localized flooding problem as it affects jurisdictions throughout the United States;
- Give reasons why communities would want to deal with these types of flood problems; and
- Explore how a community can get started to find and implement remedies for its localized flooding problems.

Part I:

Chapter 1. Background

Chapter 2. Localized Flooding

1

Background

Most cities, towns, villages, and counties in the United States have one or several clearly recognizable flood-prone areas, usually along a river or stream or other large body of water. These areas usually are identified as the Special Flood Hazard Area (SFHA) on the community's Flood Insurance Rate Map (FIRM), which is provided to the community by the Federal Emergency Management Agency (FEMA) when it joins the National Flood Insurance Program (NFIP). These flood-prone areas are properly the subject of community, State, and Federal initiatives to minimize the flooding and its impacts. The NFIP and communities address these flood-prone areas through maps, floodplain management criteria, ordinances, and community assistance programs.

However, thousands of communities also have shallow, localized flooding problems outside of the SFHA resulting from ponding, poor drainage, inadequate storm sewers, clogged culverts or catch basins, sheet flow, obstructed drainageways, sewer backup, or overbank flooding from small streams. These kinds of flood events can occur anywhere in a community.

If these localized floods occurred infrequently, the problems would be minor. However, in some areas localized flooding can be chronic, so that over the years the cumulative damage and recurring disruption from localized flooding can be more than that caused by flooding on major rivers and streams. The costs of insuring buildings that are subject to this repeated damage add up as well.

Local and State officials confirm that localized flooding is a problem. They characterize it as "a drainage issue," "low-level nuisance flooding," and "headwater flooding." According to one local official, citizens seem to present more complaints about

Photo by Michael Democker © 2003
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Flood water does not have to be deep to make a costly mess.

repetitive localized flooding than about deeper, more destructive flooding from larger bodies of water.

A community's floodplain management requirements in the SFHA will protect new construction from localized flooding. However, most communities do not have such regulations for development outside the SFHA, in areas mapped as B Zones, C Zones, or X Zones. If action is not taken, local flooding problems will likely increase over time as development in watersheds and in B, C, and X Zones continues without sufficient land use and building regulations.

The NFIP's Interest

Flood insurance is available for all eligible buildings within a community that participates in the NFIP. However, the NFIP currently has no floodplain management criteria for B, C, and X Zones—those areas that lie outside of the SFHA—and no requirements for communities to take action to reduce or prevent losses in these areas. The result is significant financial losses for the NFIP, including the cost of insuring

repetitive loss properties. Here are some statistics that show the cost of localized flooding to the NFIP:

- Since 1978 the NFIP has paid over $2.8 billion in claims in B, C, and X Zones.
  - Of that, $1.1 billion was paid for claims on repetitive loss properties.
- Between 20 percent and 25 percent of all repetitive loss properties are rated as being in B, C, and X Zones.
- In some communities, over half of the repetitive loss buildings are in B, C, and X Zones.

What is Localized Flooding?

In this guide, localized flooding refers to flooding outside the scope of criteria that apply to the SFHA as depicted on a community's FIRM. This includes areas within and outside the B, C, and X Zones. Such floods are often referred to as:

- stormwater flooding
- nuisance flooding
- flooding on small streams
- carpet wetters
- poor drainage
- ponding

About This Guide

Many State and local officials assert that their communities have put forth substantial effort to address localized flooding problems with much success. They say that, although flood mitigation is not always seen as a good use of funds in lower risk areas, communities would benefit from guidance on addressing localized flooding problems. They believe that information for both the property owner and local officials is important, and that both audiences need to understand the necessity for taking action and how reducing flood losses can benefit them and their communities in the long term.

This guide is a response to that expressed need. It is meant to help State and local officials understand what they can do to reduce the damage, disruption, and public and private costs that result from localized flooding that occurs within their jurisdictions.

Accordingly, this document

- Supports the premise that State officials, local officials, and residents can do something about localized flooding problems;
- Focuses on building a community's capability to minimize its existing localized flood problems and avoid future ones; and
- Contains ideas and techniques that can work within the existing community framework. Nothing has to be reinvented unless the community wants to do so.

This is not a technical manual; there are many excellent technical reference sources already available. Instead, this guide outlines the types of actions that can be taken, explains why they are important and what their potential benefits are, and points the reader in the direction of where to obtain more information and assistance.

How to Use the Guide

This guide is organized into four parts.

The rest of Part I (Chapter 2) describes the problems that accompany localized flooding, gives reasons why communities would want to deal with these types of flood problems, and lists general actions that can be taken by the community.

The three parts that follow describe tools and techniques that can be used for different types of flood problems. The tools should be selected carefully; certain ideas work well in some situations but not in others. Many of the techniques are best applied on a small scale, perhaps building-by-building.

Part II addresses techniques for coping with flooding that are appropriate for community-wide action, such as comprehensive planning, regulations, public education efforts, and warning systems.

Part III concentrates on the specific neighborhood or block where the flooding takes place. Techniques that are appropriate at this scale are described, including conducting an area-wide analysis, making improvements to the drainage system, or redeveloping flood-prone properties.

Part IV narrows the focus even further, offering techniques that can be used building-by-building and by individual property owners to reduce potential flood damage or how to better cope with it when it does occur. These chapters cover retrofitting and flood insurance.

A set of appendices lists sources of technical assistance and advice, along with contact information and additional recommended reading.

2 Localized Flooding

Localized flood problems sometimes do not get the remedial attention they need, partly because they are not the subject of dramatic headlines or stories on the nightly news, and partly because they fall outside the scope of many local flood protection ordinances, which are geared toward the Special Flood Hazard Area (SFHA) depicted on the community's Flood Insurance Rate Map (FIRM). However, as local officials, technical staff, and residents of those areas know, this flooding is a significant—and usually recurring—problem.

The Problem

Localized flooding can result from even minor storms. Runoff overloads the drainageways and flows into the streets and low-lying areas. Sewers back up; yards are inundated. Homes and businesses are flooded, especially basements and the lower part of first floors. Localized flooding poses most of the same problems caused by larger floods, but because it typically has an impact on fewer people and affects small areas, it tends to bring less State or Federal involvement such as funding, technical help, or disaster assistance. As a result, the community and the affected residents or business owners are left to cope with the problems on their own. Finally, flooding of this type tends to recur; small impacts accumulated over time can become major problems.

Safety Hazards

People are at risk even in shallow flooding. It is not unusual for children, especially, to drown after slipping in shallow water or to be swept into a ditch or storm drain. Even adults can be knocked down by just a few inches of moving water.

According to the National Weather Service, almost half of all flood fatalities occur in vehicles. Local storms can quickly fill underpasses and cover bridges, and even two feet of water can float most vehicles, including large ones. If the water is moving,

Village of Gurnee, Illinois

Children, as well as adults, often do not realize the danger of even shallow flood waters.

vehicles can be swept away. Driving at night during a local flood can be especially hazardous.

Emergency workers and other public employees who help in flood response and cleanup risk injury and even death themselves.

Water and electricity can lead to a dangerous situation, no matter how shallow the water. Damp electrical system components pose a shock hazard, as do the extra tools and appliances people use to clean up moist conditions.

Health Concerns

In addition to the obvious risks of drowning and electrocution, there are many less well-known health problems that can be consequences of shallow flooding, particularly if it is recurrent.

- Damp conditions can trigger the growth of mold and mildew in flooded buildings, especially if the weather is warm and atmospheric humidity high. Molds contribute to allergies, asthma, and respiratory infections, especially in children, the elderly, and those with weakened immune systems.
- Snakes and rodents are forced out of their natural habitat by flood waters and move into closer contact with people.
- Gasoline, pesticides, fuel oil, chemicals, and other substances can be brought into the area and into buildings by flood waters. They soak into the soil, building components, and furniture, and can result in long-term health problems.

- Standing water and wet conditions are breeding grounds for mosquitoes, which are not only a nuisance but also can transmit encephalitis and West Nile Virus.
- Any flood experience is a strain on individuals and families. Over time, this stress can lead to anger, conflicts with others, inability to sleep, anxiety, hyperactivity, depression, withdrawal, or lethargy.
- The stress is intensified if there is a sense that the flood water will be back because the problem has not been solved. This can worsen pre-existing medical conditions and contribute to mental health problems.

Property Damage

Even a few inches of water in the basement or ground floor of a building can cause expensive damage. Carpeting, wallboard, insulation, mattresses, and upholstered furniture must be thrown out and replaced. Flooring, studs, and other wooden parts of the building must be thoroughly cleaned and dried. Business records, photographs, and other papers are often destroyed. Many owners find it cheaper to replace flooded furniture, cabinets, contents, machinery, equipment, and inventory than to try to salvage them. Since these areas often flood frequently, the cumulative damage can be significant.

Many property owners outside the SFHA do not have flood insurance. Property and contents damage from flooding is not covered under standard homeowners insurance policies. No amount of money can compensate for ruined keepsakes, photographs, or family heirlooms.

Even under non-flood conditions, there can be some structural damage if the soils have been saturated for a long period or repeatedly over time. Foundations can be gradually undermined, wood can rot, and masonry materials can become weakened.

Disruption

Flood waters can block streets, disrupt traffic patterns, and hinder access to homes and businesses. This can affect the entire community, not just those whose property is flooded. People have to evacuate wet and/or damaged homes, and businesses have to close. Cleanup and repairs take time away from normal routines, interrupting lives and business operations. These difficulties may be serious enough to close a business permanently. All these interruptions, even if short-lived, have ripple effects

Even Minimal Risk Zones Can Be Dangerous

In 1997, a series of intense thunderstorms in **Fort Collins, Colorado**, resulted in flooding throughout the city. The Johnson Mobile Home Park, located in an X Zone, was completely destroyed, and five of its residents died in the flood.

Indiana Department of Natural Resources

Even shallow flooding results in a major cleanup and repair effort. A common approach to cleaning flooded wallboard is to cut and remove the lower 4 feet and replace those sections and the insulation.

Legal Liability for Flood Problems

When individuals receive damage from flooding or erosion they often file lawsuits against governments, claiming that the government has caused the damage, contributed to it, or (in some instances) failed to prevent or provide adequate warnings of the hazard. Such lawsuits are expensive for governments not only because damage awards are growing but also because of attorney and expert witness fees… Courts have often held governmental units liable for inadequately maintaining or operating culverts, bridge crossings, channelization projects, and dams.

Kusler (2004)

throughout a community, its citizens, its commerce, and its economy.

Costs to Local Government

Localized flooding can cause damage to public property, particularly if the flooding recurs periodically. Even though they are intended to withstand some abuse, sidewalks, streets and roads, benches, trash cans, fences, public buildings, signs, and other public property suffer additional wear and tear from flooding and will require repair, replacement, or repainting more frequently than normal.

Another cost of flooding is the diversion of local government staff and resources. Flood fighting, repairs to public buildings, extra trash collections, and cleanup of public property are all expenses that are borne by the public.

Impacts on the Community

In many instances, residents of the flooded areas complain to their local officials, wanting to know why the flooding happens and what is going to be done about it. Such dissatisfaction can even culminate in lawsuits against the local government for damage resulting from, for example, an undersized storm drainage system.

Areas that are flooded repeatedly show signs of deterioration. Buildings age before their time, and streets, sidewalks, and other infrastructure wear out sooner. Maintenance becomes harder to carry out. Property owners can be discouraged if flooding happens more than once or twice and begin to take shortcuts on some repairs, skip them altogether, or even move out and convert the building to a rental property, even if it has not been brought back up to its pre-damage condition. Some owners of repeatedly flooded properties walk away, letting the mortgage holders foreclose and resell or rent out the problem property. These approaches solve the current owner's problem, but just pass the flooding threat on to others.

Repeatedly flooded areas become undesirable places in which to live or work. Property values decline and the community's tax base is diminished.

Shallow stormwater flooding and drainage problems can have a ripple effect throughout the community's economy, social fabric, environment, and quality of life. It is a good idea to step back from the situation, take a broad look at other community concerns or problems, and decide whether localized flooding is contributing to any of them.

- Are property values falling in some areas?
- Has a once-attractive stream become a place to dump garbage?
- Is the economy periodically disrupted?

- Has the fishing declined?
- Have environmental conditions been degraded?
- Are stream banks eroding and threatening homes or bridges?
- Do more storm sewers need repairs?

All these seemingly unrelated issues may well be influencing, or be influenced by, a flooding problem. The advantage is that the solutions to the flood problem can be linked with solutions to other, perhaps more visible or popular, local concerns. They can even influence how well the community can sustain itself into the future.

What Can Be Done

Most of the time, the areas that receive shallow localized flooding are outside the community's regulatory floodplain and thus are not subject to the zoning regulations and building standards that are in place in higher-risk areas. A community may feel that it can do only what the National Flood Insurance Program (NFIP) requires and that it has no regulatory jurisdiction or the power to enforce floodplain management requirements outside the SFHA. However, there are many examples of communities throughout the United States that have taken charge of their localized flooding problems instead of focusing solely on the SFHA and the minimum NFIP criteria. These communities have worked on their own to successfully resolve their localized flooding problems by tailoring solutions to their own needs, resources, and desires. The vital first step is for community officials and residents themselves to realize that they have a problem and that they can resolve it.

Develop a Strategy

An organized approach is always best, and developing a strategy does not need to be a large undertaking. The community's approach to resolving a localized flood problem can be a formal plan, such as a community hazard mitigation plan, or it can be a simple decision to take a couple of visible steps in the right direction. Whatever is decided, the strategy should address the real needs and desires of the community, or at least those of the neighborhoods with flood problems. As detailed in Chapter 3 and Chapter 7, finding out what those concerns are lays the foundation for a plan that can be implemented successfully.

Coordinate with Other Concerns

A remedy for a flooding problem can also be a remedy for some other local concerns, and vice versa. Finding ways to combine solutions to these problems can be the key to simultaneously improving life in the community and alleviating flooding.

- Does the community/neighborhood need a park? A low-lying area converted to public space could fulfill that purpose and also provide needed storage for stormwater to alleviate flooding of nearby homes or businesses.
- Does the community/neighborhood need after-school activities for young people? Cleaning accumulated debris out of a stream channel and "adopting"

it can minimize flooding and provide an educational experience for middle and high school students.

- Have residents or businesses in certain neighborhoods been asking for sidewalks? Combining the installation of this infrastructure with drainage works can make pedestrians safer and can also direct stormwater to a more appropriate location.
- Has the downtown area been declining? If it is flood-prone, a project to mitigate the flooding could support revitalization efforts, and vice versa.

Orland Hills Solves its Flood Problems

Village of Orland Hills

Figure 2-1

Village of Orland Hills

Figure 2-2

The Village of Orland Hills, Illinois, had a varied and widespread flooding and drainage problem that affected buildings, yards, and streets throughout town. Heavy rains caused water problems several times each year.

The Village has a FIRM, but the mapped SFHA is relatively small and 82 percent is preserved as open space. The chronic flooding situations faced by Orland Hills residents were caused by local drainage problems. Regulating floodplain development and other traditional flood control approaches would not help.

Accordingly, the Village created a Committee that prepared a Flood Protection Plan in 1995. It reviewed problems with maintenance of open ditches and detention basins. Many of the problems were preventable.

> *In some areas, weeds and brush have been allowed to grow. Rocks placed as rip rap on the banks have been moved to the channel bottom, apparently by children. Figure 2-1 shows where the rip rap has been moved to plug a detention basin inlet.*
>
> *The worst problem in the channel is the condition of some of the culverts. As shown in the profiles, the culverts are so small that they act as dams even when clear. Over time, debris collects in them, rip rap is moved to block them, and they suffer from wear and tear. The pipes under 93rd Avenue have apparently separated, resulting in a hole in the overlying fill. Figure 2-2 shows this culvert and the barricade that has been placed over the hole.*

Flood Protection Plan, Village of Orland Hills, 1995, pp. 2-6–2-7.

Village of Orland Hills

Figure 2-3

Village of Orland Hills

Figure 2-4

The Plan identified storm sewer backup and yard drainage as major causes of the continuing problems. The Plan also noted that many of the problems were caused by the owners themselves:

> *Over the years, this drainage system has been disrupted. Many property owners are not aware of the need to keep their easements and swales open. They installed sheds, planters, railroad ties, or swimming pools in the easements. They built fences right on their lot lines to enclose the largest part of their properties. Figure 2-3 shows this process in one of the newest areas of Orland Hills. The low swale in the middle of the picture is being encroached upon by the new fences.*
>
> *Early homes in Orland Hills, especially homes on crawlspaces, were built at the original ground level. Later home builders, especially for tri-levels, added fill around the lots. This provided positive drainage from the lot, protected the lower areas from drainage problems, and improved the appearance of the site.*
>
> *Now when it rains, the runoff goes downhill to the lowest point: the older buildings that did not backfill or raise their lots. Directing downspouts and sump pump discharge pipes toward the property line aggravates the problem. Often the first property developed becomes the recipient of runoff as later builders fill in their lots. An example of this is seen in Figure 2-4.*

The *Flood Protection Plan* recommended a range of activities that have since been implemented:

- Tougher enforcement of easement restrictions;
- Passage and enforcement of a stream-dumping ordinance;
- Initiating a formal drainage maintenance program that inspects all ditches and storm sewers several times each year and after every heavy rain;
- Small scale projects to correct local problems, including televising storm sewers and rehabilitating broken ones;
- Site visits to determine the causes of local flooding problems and to advise property owners about what they can do; and
- A public information program that includes articles in the Village newsletter, annual letters to residents in problems areas, cable TV "crawlers," and an annual public information campaign theme, such as "Don't forget your drainage."

Since these efforts were started, Village staff report that the number of flooding complaints has decreased dramatically. They noted that some easement and dumping violations were reported by neighbors, a sign that the public information activities were paying off.

In 1996, Orland Hills joined the NFIP Community Rating System (CRS). Village officials found CRS materials helpful in designing their program and the annual reporting requirements helpful reminders to keep their programs going. They note that there are more advantages to the CRS than the direct financial reward to the policyholders. Orland Hills is currently a CRS Class 5, one of the best in the nation, even though there are only 22 flood insurance policies in the Village.

Solving Localized Flooding—Value Added

- Property and neighborhoods are preserved and often improved.
- The lives of residents and emergency personnel are protected. Fewer floods mean fewer opportunities for injuries and accidents to occur.
- The health of community residents is safeguarded; unhealthy and stressful situations are minimized.
- The economic viability of the community is maintained.
  - Disruption and economic losses from flooding are reduced or eliminated.
  - Business interruptions and permanent closures are minimized.
  - Public (local) costs of flood response and recovery are reduced or eliminated.
  - Property values and the local tax base are preserved.
- Legal liability is minimized.
- Credit for certain activities can be obtained under the CRS, resulting in lower insurance premiums for all flood insurance policyholders in the community. Even policyholders outside the SFHA receive a 5 to 10 percent reduction in their premiums.
- Making progress, and especially participating in the CRS, provides both an incentive for more organized and permanent local floodplain management, stormwater drainage, public awareness, and other activities.

Pick an Activity and Do It

Start with an action item listed in the plan or strategy that is easy, or inexpensive, or can be added on an existing activity. An early success will give people a sense of accomplishment and encourage moving on to the more difficult or complicated tasks. After that, priorities will have to be set by the community based on identification of the most visible problems and the resources that are available, as well as other factors. The area analysis process described in Chapter 7 offers some ideas of the factors to be considered in setting priorities.

Any initiative will fall into one of the three general categories of approaches listed below. These are based on the scale of the area and number of people affected, going from broad to narrow. The rest of this guide is organized according to this scheme.

- Organize **community-wide activities** (Part II of this guide) to make a broad impact and/or obtain wider support. This includes local planning and bolstering the capabilities of community staff (Chapter 3); and assessing regulations, mapping, building standards, zoning, and other techniques that apply to the whole community, even if there are different provisions for certain areas (Chapter 4). Public awareness and education campaigns (Chapter 5) and flood warning systems and emergency services (Chapter 6) also are best handled at the community level.
- Tackle each **neighborhood problem area** individually (Part III). In many cases, several homes and/or businesses suffer flood problems for the same reason, whether it's their location in a low-lying area or an inadequate storm drain or culvert. The local government will probably be the entity to carry out neighborhood-level projects or programs, but involving residents as much as possible is essential. The area analysis recommended in Chapter 7 encompasses this idea. Neighborhood associations or even ad hoc groups of property owners can be a big help in spreading the word, developing ideas, and garnering citizen support for changes such as drainage improvements (Chapter 8) and even redevelopment (Chapter 9).
- Deal with **individual buildings**. The flood risk to some flood-prone structures cannot be mitigated through a community-wide or neighborhood-level approach. These buildings need special attention to make them resistant

to flooding. Another reason to work on a single-building basis is that convincing one property owner to take protective measures for his or her property may well induce others in the area to follow. Often people are hesitant because they don't know what the finished product will look like or because they are unfamiliar with the problem or the techniques that can solve it. An individual success can induce others to take action and lead to a bigger project, if needed.

Part IV explains the best techniques to use on individual structures, namely, retrofitting (changing a building or part of it to make it more resistant to flood waters) in Chapter 10, and flood insurance, discussed in Chapter 11.

Join or Advance in the Community Rating System

Under the NFIP Community Rating System (CRS), a community receives a classification based upon credit points that are awarded for conducting activities to reduce flood losses, such as better mapping, stronger regulations, public information campaigns, flood damage reduction projects, and/or flood warning and preparedness programs. The credit points earn reductions in flood insurance premium payments for all NFIP policyholders in the community, even those outside the floodplain.

The CRS has made the Village think more proactively about stormwater management, instead of just waiting for the next big rain.

— Gary Salavitch, Village of Hoffman Estates, Illinois

But participating in the CRS is not just about saving people money. Belonging to the CRS provides an incentive not only to start new flood mitigation activities, but also to keep them going. A CRS community must recertify each year that it is continuing the activities for which it receives credit. The recertification is a simple procedure, but it serves to keep local attention focused on the importance of these ongoing activities. Further, in the process of applying for the CRS, a community receives help on and feedback about parts of its flood reduction program, which improves staff expertise and generates new ideas. Some communities say that the CRS has changed the way their programs work, even without budget increases.

Because there are 10 levels (classes) in the CRS, even communities that already participate can benefit from undertaking additional flood-related activities. They will receive greater premium discounts and can take advantage of the expert assistance, information, and contact with other communities.

Where to Get Help

- The Community Rating System Web site is http://training.fema.gov/emiweb/CRS/.
- The Web site of the Association of State Floodplain Managers (ASFPM) is http://www.floods.org.
- Information on the NFIP can be viewed at http://www.fema.gov/nfip/.
- Examples of how localities have solved flood problems can be found easily on the Web. Search for "mitigation success" or go to http://www.floods.org/Publications/mitsuccstories/mssiii1.htm.

Additional resources are listed in Appendixes A and B.

The Community Rating System

The CRS rewards communities for what they are doing to reduce flood losses and also provides an incentive for new flood protection activities. The reward is a reduction in flood insurance premium rates. A community's efforts are rated and identified by a CRS classification, with an accompanying discount on the annual premiums for policyholders in the community (see table below).

Application. To apply, a community submits worksheet pages from the CRS Application that show what it is doing and that its activities earn at least 500 points. After the activities are verified through a field visit, The Federal Emergency Management Agency (FEMA) sets the credit to be granted and notifies the community, the State, and insurance companies of the rating.

Recertification. Each year the community must recertify that it is continuing to perform the activities that are being credited by the CRS, and submit documentation in the form of copies of projects conducted during the year, progress reports, and similar items.

Community Responsibilities. A community in the CRS must:

- Designate a CRS Coordinator;
- Cooperate with the verification of its credited activities;
- Continue to implement its activities, and certify each year that it is doing so, with appropriate documentation;
- Advise FEMA of modifications to its activities;
- Address any identified repetitive loss issues;
- Maintain elevation certificates, other permit records, and old FIRMs forever; and
- Maintain other records of its activities until the next verification visit.

CRS Activities. The CRS credits a range of local (and State) activities that operate to reduce flood losses, promote flood insurance purchase, and facilitate accurate insurance rating. The four main categories and 18 creditable activities are listed in the box below.

Information. Technical assistance is available for communities applying for and participating in the CRS. No fees are charged for application, publications, or participation. The *CRS Application,* the *CRS Coordinator's Manual,* and all other CRS publications are free and can be obtained by calling 317-848-2898 or e-mailing NFIPCRS@iso.com, or downloaded from http://training.fema.gov/emiweb/CRS/.

Credit Points	CRS Class	Credit		
		SFHA*	Non-SFHA*	A99/AR Zones
4,500+	1	45%	10%	10%
4,000 - 4,499	2	40%	10%	10%
3,500 - 3,999	3	35%	10%	10%
3,000 - 3,499	4	30%	10%	10%
2,500 - 2,999	5	25%	10%	10%
2,000 - 2,499	6	20%	10%	10%
1,500 - 1,999	7	15%	5%	5%
1,000 - 1,499	8	10%	5%	5%
500 - 999	9	5%	5%	5%
0 - 499	10	0	0	0%

CRS Classifications

* SFHA: the floodplain shown on the community's FIRM.

CRS Activities

300 Public Information Activities
- 310 Elevation Certificates
- 320 Map Information Service
- 330 Outreach Projects
- 340 Hazard Disclosure
- 350 Flood Protection Information
- 360 Flood Protection Assistance

400 Mapping and Regulatory Activities
- 410 Additional Flood Data
- 420 Open Space Preservation
- 430 Higher Regulatory Standards
- 440 Flood Data Maintenance
- 450 Stormwater Management

500 Flood Damage Reduction Activities
- 510 Floodplain Management Planning
- 520 Acquisition and Relocation
- 530 Flood Protection
- 540 Drainage System Maintenance

600 Flood Preparedness Activities
- 610 Flood Warning Program
- 620 Levee Safety
- 630 Dam Safety

RETURN TO TABLE OF CONTENTS ADVANCE TO CHAPTER 3

Part II

Community-Level Tools and Techniques

The first part of this guide reviewed the problems created by localized flooding and the reasons why a community should take actions to protect people and property from the hazard. Chapter 2 noted that actions can be taken at three different levels: community-wide, neighborhood, and individual structures.

Part II addresses the broadest of these levels: techniques for coping with flooding that are appropriate for community-wide action. First, Part II describes a community planning process that will help determine and build support for appropriate flood mitigation activities. It will also meet the planning prerequisite for several Federal funding programs. Next, various regulations are discussed that a community can apply to its flood-prone areas. The usefulness and potential of public information campaigns and projects are presented. Finally, Part II explores what a community should do to improve its warnings for localized flooding, as well as its preparedness for a flood emergency.

Part II:

Chapter 3. Community-Level Activities

Chapter 4. Regulatory Tools

Chapter 5. Public Information and Awareness

Chapter 6. Warning and Emergency Service

3

Community-Level Activities

This chapter reviews the three parts to organizing community-level activities: (1) determining an overall strategy, (2) preparing a more detailed plan, and (3) building capabilities to implement flood-protection actions. As used in this guide, a "community" is any city, village, town, county, or other local government with authority to enact floodplain management measures.

The Strategy

A community should have an overall strategy that outlines how it will address its localized flooding problems. It may be as simple as doing nothing or funding drainage improvements in response to complaints. The more the community intends to do, the more involved the strategy must become.

The Document

Many communities have unwritten strategies or strategies that change when leadership changes. To be effective, the strategy should be written. A written document provides a clear statement that will be consistent over time. It also shows how individual actions fit in the bigger picture. The best approach would be a document adopted by the governing board, such as a resolution.

A strategy or resolution can be as short as one page. No special format is needed, but it should recognize that there is a problem and identify the key policies and actions that will be pursued. An example is on pages 3-4 and 3-5. Circulating a draft for comments by the appropriate staff will help gain their support and ensure that the policies and actions are realistic.

Strategy Statements

Strategy statements will depend on the problems, resources, and the community's level of commitment to take action. Examples include:

- All reports of localized flooding problems will be investigated by municipal engineering, utility, or public works staff to determine the cause and most appropriate solution.
- New buildings constructed in flood problem areas must be protected to the highest recorded flood level, even if they are not in the Special Flood Hazard Area (SFHA) mapped on the community's adopted Flood Insurance Rate Map (FIRM).
- Land development regulations will be reviewed to determine if revisions would help prevent localized flooding problems or exacerbate existing problems in the future.
- All residents in areas with localized flooding problems will be encouraged to purchase and maintain flood insurance.
- All buildings will be constructed with positive drainage away from the building.

The rest of the chapters in this book can be used as a checklist to identify actions that can be pursued by the community and included in the strategy document. The more time spent reviewing what should be done, the more detailed the strategy can be. However, there comes a point at which the level of detail is sufficient for the community plan to be prepared, reviewed, and adopted.

Long-Term Strategies

Some communities have short-term and long-term strategies. Short-term strategies might include small-scale drainage modifications and encouraging people to buy flood insurance. The long-term strategy could be to prepare a flood mitigation plan that sets out a more comprehensive approach to the problem.

A Community Plan

A community-level plan is more formal and detailed than a strategy statement. It summarizes the problem(s), sets goals, reviews alternative actions, and selects those actions that will best reduce the problem. It is a systematic and thorough review of what can be done. It should take more time and involve more people than a simple strategy.

Benefits

A well-prepared plan will:

- Ensure that all possible activities are reviewed and implemented so the local problem is addressed by the most appropriate and efficient solutions;
- Ensure that individual activities are coordinated with other community goals and activities, preventing conflicts and reducing the costs of implementing each activity;
- Coordinate local activities with Federal, State, and regional programs;

- Educate residents on flood problems, flood insurance, and loss-reduction measures;
- Build public and political support for mitigation projects; and
- Fulfill planning requirements for State or Federal mitigation grant funds.

The Process

Plans can come in a variety of formats and organizational styles. The format and organization of a plan is not important, but the *process* of planning is.

The planning process provides a framework within which planners, local officials, residents, engineers, technical experts, stakeholders, and others can work out the details and reach a consensus on what should be done. The process works for all types of plans, such as comprehensive plans, land use plans, capital improvement plans, neighborhood redevelopment plans, hazard mitigation plans, stormwater management plans, and floodplain management plans.

The City of Conway, South Carolina, was severely flooded by Hurricane Floyd in September 1999. The Waccamaw River and its tributaries flooded areas that were mapped as X Zones on the community's FIRM. Acting quickly, before the waters receded, the City Council passed a resolution that spelled out its strategy:

- All properties, including those not in the SFHA, would be inspected and subject to the same reconstruction requirements.
- A mitigation plan would be prepared to identify a long-term solution.
- Residents would be helped with information and financial assistance.

The resolution appears on the next two pages.

Planning Guidance

The Federal Emergency Management Agency (FEMA) has published various guidance documents over the years, and they all agree on four basic phases to developing a mitigation plan:

1. Organize for the effort and involve affected parties, especially the public;
2. Assess the hazard and the community's exposure to damage by the hazard;
3. Set goals and review and select appropriate measures to reach those goals; and
4. Adopt, implement, evaluate, and revise the plan periodically.

There are four FEMA programs with planning criteria: the three major flood mitigation funding programs require a plan as an application prerequisite, and the Community Rating System (CRS) has credit criteria for floodplain management planning. The chart on page 3-6 shows that the planning process the community uses can meet the prerequisites of all these programs.

One planning effort can meet the community's needs and meet the criteria of several different programs, including hazard mitigation grants, the CRS, the Natural Resources Conservation Service, and the Corps of Engineers' project prerequisite. Planners should review the criteria of each program to ensure that their efforts will qualify for all the programs' benefits.

These programs have published guidance documents that are listed in the last section of this chapter. Furthermore, flood control assistance from the U.S. Army Corps of Engineers also has a floodplain management plan requirement. The Corps of Engineers' guidance states that a plan that meets the CRS criteria under Floodplain Management Planning, Activity 510, will fulfill this requirement.

Resolution by the City of Conway, South Carolina, After Flooding from Hurricane Floyd in 1999

WHEREAS, properties along the Waccamaw River and its tributaries in the City of Conway have been severely flooded, are currently uninhabitable, and according to the best available information, may be substantially damaged;

WHEREAS, the floodplain ordinance of the City requires substantially damaged residences to be either elevated or demolished and either option can place a hardship upon the owners;

WHEREAS, the City Council has discussed various alternative ways to redevelop the area but none has yet been reviewed in depth and none has been based on full knowledge of the condition of the buildings or the desires or financial conditions of the owners; and

WHEREAS, several of the redevelopment alternatives reviewed to date may conflict with each other, may jeopardize the availability of flood insurance to residents, and/or may not be in the long term best interests of the residents or the community;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Conway that:

It is the policy of the City of Conway to:

1. Keep the City in good standing in the National Flood Insurance Program to ensure that all residents can obtain financial assistance and flood insurance to protect their properties from flood damage;

2. Not allow any reconstruction or reoccupation of flooded buildings or homes until the City Building Official or his duly authorized representative has inspected the site and issued a building permit;

3. Carefully develop a mitigation plan for the affected area after a review of all options (including flood control, reconstruction, elevation, floodproofing and relocation) based on building conditions, the desires of the property owners, and funding sources that are available to assist the property owners; and

4. Assist residents with information on relocation and other flood protection measures and help them obtain financial assistance.

To implement this policy, be it hereby resolved that:

1. Every building that has been flooded must have an inspection by the Building Official or his duly authorized representative before it is repaired or reoccupied. If the level of damage is minor, the Building Official may issue a letter saying that clean up may proceed without a permit. There is no fee for such inspection or for the subsequent permit to repair or rebuild a flooded building.

2. A Mitigation Planning Committee is hereby established. Its members shall be:

(The City of Conway citizens' names have been removed, but their representation on the committee is the following)

Chair – banker, floodplain resident and former city manager
Vice-chair – floodplain resident
Floodplain resident
Floodplain resident
Floodplain resident
Council member, floodplain resident
Council member, floodplain resident
Director of Planning
Building official, floodplain resident
Floodplain resident
Grants/special projects coordinator
Floodplain resident

3. The Mitigation Planning Committee is charged with the following:

(continued on facing page)

(continued from page 3-4)

a. Collect data on building conditions, the desires of the property owners, and funding sources for reconstruction and redevelopment in the flooded area;

b. Recommend reconstruction and redevelopment policies and procedures to be followed by the City;

c. Identify particularly hard hit areas that could be designated as target areas appropriate for acquisition, clearance and conversion to open space;

d. Prepare a post-flood hazard mitigation plan for the City that designates target areas and recommends mitigation measures appropriate for the flood hazard facing the City; and

e. Keep the public informed of its deliberations and recommendations.

4. Upon the advice of the mitigation planning committee, the City Council may adopt a moratorium to prohibit reconstruction of buildings in certain target areas until the mitigation plan is adopted.

5. Owners of property in the affected area are encouraged to:

a. Attend public meetings to review the City's mitigation planning activities and recommendations;

b. Cooperate with the building inspectors in order to help determine the condition of their buildings and to collect accurate data as quickly as possible; and

c. Assist in the preparation of the mitigation plan by providing information on the condition of their buildings and whether they are interested in relocating to a flood free location.

Passed this 27th day of September 1999.

Building Capabilities

Once the strategy has been decided or the plan has been drafted, the community should prepare to implement it. A formal plan will identify who is responsible for each action item, when it will be accomplished, and what will be the source of funding. A strategy may not be so specific; however, certain activities should be pursued in a strategy.

Assign Staff Responsibilities

An activity identified in a strategy or an action item in a plan will not be implemented if no one is responsible for it. The strategy resolution or the mayor should designate offices or individual staff members as the lead for each activity.

In most cases, the responsibility will be obvious: the public works department is responsible for drainage maintenance and the planner is responsible for plans. The discussion in the following chapters includes typical contacts and responsible offices for the various mitigation tools and techniques.

FEMA How-to Series		Hazard Mitigation Grant and Pre-Disaster Mitigation Program (DMA 2000 Plan Criteria)	Flood Mitigation Assistance Program	Community Rating System Floodplain Management Planning (10-Step Process)
Planning Requirements	**Phase 1 Organize Resources**	Coordination among agencies	Coordination with other agencies or organizations.	Coordination with other agencies
		Integration with other planning efforts	Involve the public, including a description of the planning process. Public involvement may include workshops, public meetings, or public hearings.	Involve the public
		Involve the public throughout the planning process		Organize to prepare the plan
		State coordination of local mitigation planning		
	Phase 2 Assess Risks	Identify all hazards	Flood hazard area inventory that identifies the flood risk, including estimates of the number and types of structures at risk and repetitive loss properties.	Assess the flooding hazard
		Profile hazard events		
		Assess vulnerability	Problem identification, including a description of the existing flood hazard, the extent of flood depth and damage potential, and the applicant's floodplain management goals.	Assess the problem
		Estimate potential losses		
	Phase 3 Develop the Mitigation Plan	Documentation of planning process	Review of possible mitigation actions, including the identification and evaluation of cost-effective and technically feasible mitigation actions.	Set goals
		Capability assessment		Review possible activities
		Develop hazard mitigation goals		Draft an action plan
		Identification and analysis of mitigation measures		
		Funding sources		
	Phase 4 Implement and Monitor Progress	Adoption	Documentation of the formal plan adoption by the legal entity submitting the plan (e.g., Governor, mayor, county executive).	Adopt the plan
		Implementation of mitigation measures		Implement, evaluate, and revise the plan
		Implementation through existing programs		
		Monitoring, evaluation, and updating the plan		
		Continued public involvement		

FEMA 386-3 (2000, p. xi)

The planning requirements and processes that are used for FEMA programs and described in various guidance documents coincide as shown in this chart. It should be noted that a CRS publication, Example Plans, *provides guidance that will meet all three programs' criteria. It is available at http://training.fema.gov/emiweb/CRS/.*

Educate Staff

Although it may be obvious that the planner is responsible for plans, the community's planner may not be familiar with flood mitigation planning. There are many publications and training programs, as well as references in this guide, that can help educate or train staff on flood protection tools and techniques.

Get Help

A community should not duplicate the efforts of others. Nor should it try to solve all its problems by itself. Other government agencies and private organizations may be implementing activities that can affect flooding in the community. Many agencies and organizations can provide:

- Flood hazard data and maps;
- Technical information on flood mitigation tools and techniques;
- Guidance on regulatory requirements;
- Advice and assistance in the planning effort;
- Staff training;
- Implementation of an activity; and/or
- Financial assistance.

The lists in Appendixes A and B give agencies, organizations, and other resources that can be consulted for help in planning and conducting local flood mitigation activities.

Help can also be hired. A community may turn to a consultant if it concludes that:

- It does not have enough staff;
- It does not want to hire staff for a short-term project; or
- It wants help from someone with specialized knowledge.

At the end of each chapter of this guide is a section called "Where to Get Help," which lists relevant and helpful agencies and organizations. Those entities should be contacted for assistance or for information on qualified consultants who can help the community's efforts.

Integrate Activities

The best way to ensure that an activity will be implemented is to incorporate it into existing programs and activities. If staff members modify their work or accept assignments as part of their regular duties, the activity will become part of the community's routine responsibilities. Integrating the flood protection tools and techniques into ongoing activities also reduces the financial impact on the community.

A Planning Success Story

After a flood in 1990, Village officials of **South Holland, Illinois**, were faced with many angry residents who were convinced that the Village was not doing enough to protect them from flooding. The Village formed a Flood Liaison Committee so residents and staff would work together.

The Committee spent a year preparing a floodplain management plan that reviewed all the alternatives and recommended 31 action items. The Village began providing technical assistance and a floodproofing rebate program that has helped fund 450 self-help retrofitting projects to protect homes from local flooding.

Residents are now active participants in the Village mitigation program. South Holland has since received one of the highest ratings in the CRS (Class 5), has received state and national awards, and has played a lead role in the initiation of a watershed-wide flood and stormwater mitigation planning effort.

The Flood Liaison Committee still meets to provide oversight of the staff's activities and to monitor, evaluate and recommend revisions to the plan.

Wetmore and Jamieson (1999)

The integration of activities is discussed in the chapters that follow. Examples include:

- Modifying subdivision regulations to include stronger drainage and stormwater management standards, rather than adopting a new set of regulations;
- Adding flood protection topics to water quality public information materials instead of creating and printing new brochures;
- Coordinating park and open space planning with floodplain property acquisition efforts, using Federal mitigation funds to help expand recreation lands; and
- Using experienced housing rehabilitation staff to provide retrofitting advice and/or administer retrofitting financial assistance funds.

Evaluate

A periodic review of activities included in the strategy or plan can be helpful. The community should determine if the activities are being implemented and, if so, whether they are effective. At the same time, the basis for the strategy or plan should be evaluated to determine if they are still relevant and whether new activities are needed.

Periodic monitoring, evaluating, and, if necessary, revising the activities recommended by a floodplain management or hazard mitigation plan are requirements of the FEMA planning programs. They are good measures to include in a strategy.

Where to Get Help

- FEMA's Planning Resource Page at http://www.fema.gov/fima/planresource.shtm.
- *Flood Mitigation Planning—The First Steps*, Association of State Floodplain Managers (ASFPM), 2001, is a floodplain management planning kit consisting of reference materials, masters that can be duplicated for handouts, and a 2-part video that explains the 10-step process to the general public. It is designed to be shown at the first meeting of a planning committee. Order through the ASFPM Web site at http://www.floods.org or call 608-274-0123.
- FEMA Regional Offices (see Appendix A).

- State National Flood Insurance Program coordinating office and the State emergency management agency's mitigation office can be located at http://www.floods.org/StatePOCs/map.asp and http://www.fema.gov/fema/statedr.shtm, respectively.
- American Planning Association at http://www.planning.org.
- The Insurance Services Office (ISO) administers the Community Rating System on behalf of FEMA. For technical assistance in preparing a floodplain management plan, contact NFIPCRS@ISO.com.
- Publications and other information about the CRS, including its planning components, are available at http://training.fema.gov/emiweb/CRS/.
- Regional planning commissions and councils of government often help communities with planning or prepare plans for them.
- Training courses in floodplain management, flood insurance, the CRS, building protection, and other matters are offered by the Emergency Management Institute. Tuition is usually free to local government staff. The schedule and course descriptions can be found at http://www.fema.gov/emi/.
- If there is a State-level professional association for floodplain managers, wetlands managers, stormwater managers, or others, it can be a resource for technical training opportunities for local staff. Floodplain management associations can be found at http://www.floods.org/StatePOCs/stchoff.asp.
- The State emergency management agency can be contacted for technical training schedules for local staff.
- Three FEMA programs provide financial assistance for flood or hazard mitigation planning on a 75%/25% cost share:
  - Flood Mitigation Assistance program (FMA)
  - Pre-Disaster Mitigation program (PDM)
    - In the PDM grant program, special consideration will be given to small and impoverished communities and they may be eligible for a 90%/10% split.
  - Hazard Mitigation Grant Program (HMGP).

  The State emergency management agency and the FEMA Regional Offices have more information about these funding programs. (Note that the Flood Insurance Reform Act of 2004 has a special provision under which the cost share for mitigating repetitive loss properties may be 90%/10%, but regulations to implement this change have not yet been finalized.)

- Many States have prepared their own floodplain management or mitigation planning guidance. It is usually found at the State's emergency management or National Flood Insurance Program (NFIP) coordinating office. The user should verify that the State guidance includes the latest criteria from the *CRS Coordinator's Manual* and the Disaster Mitigation Act of 2000.

Additional resources are listed in Appendixes A and B.

4

Regulatory Tools

In almost all cases, it is less expensive and less disruptive for a community to prevent flood problems from occurring than to mitigate problems that already exist. Regulatory tools can be designed to protect new buildings from flooding and to prevent new development from creating new or aggravating existing flood problems. The National Flood Insurance Program (NFIP) and its Community Rating System (CRS) are good starting points for reviewing regulatory tools.

To participate in the NFIP, communities are required to adopt and enforce regulations to manage new development in the Special Flood Hazard Area (SFHA) shown on the Flood Insurance Rate Map (FIRM). As noted in Chapter 2, significant damage can occur in the areas outside the SFHA in the B, C, and X Zones.

To prevent new development from making its localized flood problems worse, a community needs to do more than just enforce its NFIP regulations. The many regulatory tools that help minimize flooding and flood damage are discussed under the five main sections of this chapter:

- Adopting a map showing additional flood-prone areas to be regulated;
- Planning and zoning for appropriate development in flood-prone areas;
- Setting standards for new subdivisions;
- Setting standards for new buildings in flood-prone areas; and
- Regulating site drainage.

A Regulatory Floodplain Map

The first step in managing new construction to protect it from flood damage is to determine what areas are subject to regulation. The NFIP has published the community's FIRM, but this should be considered as only a beginning. The regulatory floodplain on the FIRM may not adequately identify all of a community's at-risk

areas. There are several reasons why some local flooding areas may be missing from the community's FIRM.

- Smaller problem areas do not show up as SFHAs because Federal Emergency Management Agency (FEMA) mapping standards focus on larger flood problems, such as watersheds larger than 1 square mile.
- Conditions may have changed since the study was conducted to produce the FIRM, which could have been as long as 10 or 20 years ago.
- When the FIRM was prepared, an area may not have been known to have a flood problem or it may not have had much development activity, so it was not studied.
- The study criteria may not have reflected all types of flood-related hazards, such as land subsidence.

In Activity 410 (Additional Flood Data), the CRS encourages and provides credit for several mapping activities:

- Providing regulatory flood elevations in X and approximate A Zones;
- Restudying and remapping areas shown on the FIRM;
- Requiring developers to produce regulatory flood elevations in smaller watersheds; and
- Studying hydrology based on future watershed conditions.

In short, FIRMs cannot be expected to show every flooding problem in the community, especially flooding caused by local drainage or storm sewer problems. However, because these problems are more frequent than the major flooding shown on the FIRM, and because the drainage or sewer system is a local responsibility, it is likely that the community has additional information that could be used to supplement the FIRM's presentation of the community's flood hazard.

Communities can do much to provide a better floodplain map and regulatory data. This section explains four valuable options for improvement:

1. Use more accurate elevation contour information to map flood elevations provided with the FIRM;
2. Restudy local flood-prone areas and produce a new regulatory floodplain map;
3. Require permit applicants to provide needed flood data; and
4. Develop new flood hazard maps and data using more exacting study techniques.

More Accurate Contour Map

When a community's FIRM is prepared, the study contractor uses the best base map available at that time. In many cases, it could be a U.S. Geological Survey quadrangle map with a 5- or 10-foot contour interval. Since their FIRMs were prepared, many communities have developed geographic information systems (GIS), often with more recent and more accurate elevation data.

A community should check to see if there is a new base map with more accurate topography. This could be the product of recent surveying, analysis of ortho-rectified aerial photos, or light detection and ranging (LIDAR) (the use of an airborne laser

system to prepare topographic maps). Such a base map may have recently constructed roads, bridges, and other human-made features, 1- or 2-foot contour intervals, or contour information that is more accurate or more recent than that used to prepare the FIRM.

If there is a more accurate and more recent contour map, the 100-year flood elevations from the Flood Insurance Study's flood profile should be plotted on it. Such an exercise may well reveal that the boundaries of the SFHA should be different. Gurnee, Illinois, found this to be true, as depicted in the adjacent map.

Many times, such a review finds that the FIRM understates the true inundated area and the SFHA should be extended into the X Zone. If this is the case, it is recommended that the community adopt this more accurate map in its floodplain management regulations.

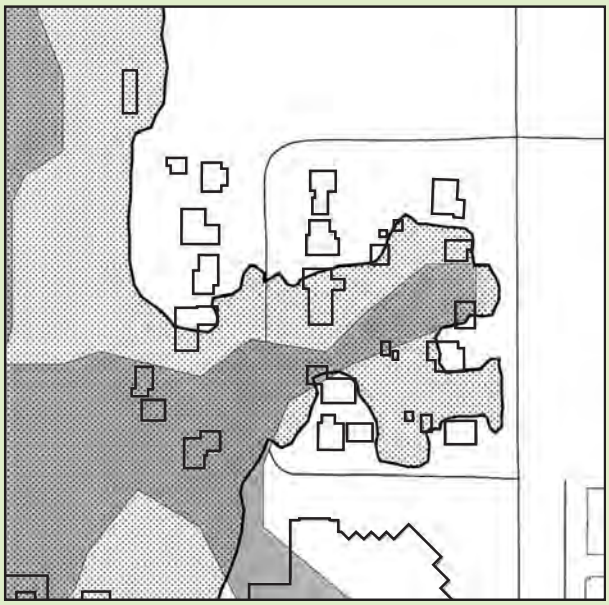
Another approach is to record the high-water marks and note the areas flooded if a recent flood extended outside the boundaries of the SFHA. That is what the City of Conway, South Carolina, did after Hurricane Floyd sent the Waccamaw River flooding into its X Zone in 1999. The city adopted the area flooded by Floyd as its new regulatory floodplain (see page 4-5).

A third approach to capture more of the flood-prone areas is to regulate the mapped floodplain plus all areas 1 foot higher than the base flood elevation (BFE). Development on properties outside the SFHA, but within 1 foot of the BFE, would need a floodplain permit. If the developer produces accurate ground elevation data that show the building site above the BFE, the floodplain regulations would not apply.

A variation on this approach is to regulate to the next higher contour line. For example, a site located between a BFE of 145 and one of 146 would be mapped at the 146 contour line. A disadvantage of this method is that elevations are not increased by a constant amount (for example, 145.1 and 145.9 both round to 146).

New Flood Study

Using more recent or more accurate elevation data is a relatively inexpensive way to get a better flood map from existing flood data. Another approach to getting a new floodplain map is to conduct a new flood study



Gurnee, Illinois, put its FIRM flood elevations onto a more accurate base map and found these differences, identifying other areas that could be susceptible to flooding.

New Maps vs. FIRM

Adoption of a different map in the local ordinance is allowed by the NFIP regulations, provided the new map covers a larger floodplain than the FIRM does. In fact, exceeding the NFIP minimum criteria is encouraged by FEMA. However, two things should be noted:

- The community's map will not affect the current FIRM or alter the SFHA used for setting insurance rates or making map determinations.
- Under 44 *Code of Federal Regulations* 65.3, as "soon as practicable, but not later than six months after the date such information becomes available, a community shall notify [FEMA] of the changes by submitting technical or scientific data…." The State NFIP Coordinator or the FEMA Regional Office should be contacted for instructions on how this is done (see contact list in Appendix A).

to produce new flood data. The new study could either cover the same area mapped as SFHA on the FIRM or areas outside the SFHA that have been known to flood or have repetitive flood problems.

In the SFHA, the community's new study must use the same or similar study techniques as for a detailed study on a FIRM. These techniques can be expensive, but the study may help with activities other than regulations. As noted in Chapters 8 and 10, a new flood study and watershed model can help greatly when planning drainage modifications or selecting a design protection level for a retrofitting project.

Typically, FIRMs do not include the floodplains of streams with a drainage area of less than 1.0 square mile in urban areas and even larger drainage areas in rural areas. Therefore, if there is a localized flood problem that should be mapped in order to guide development regulations, the area will most likely have to be studied by the community.

If the area is outside the SFHA, the community can use any technique it prefers. Areas not previously studied have no minimum standards. Probably the least-expensive approach is to use the flood of record, i.e., to map out the areas that were under water during the highest recorded flood. Communities that use this approach usually add a safety margin of a foot or two to the flood-of-record's crest as the basis for a regulatory flood elevation.

It should be noted that using historical floods does not necessarily treat everyone the same. In some areas, the historical flood of record may be the 100-year flood, but in other parts of a community, it may be the 25-year flood. It is especially difficult to be consistent when some areas were developed in the last 10–20 years, so there is a relatively short history of known flood problems.

Cooperating Technical Partners

In conjunction with the Map Modernization Program, FEMA establishes partnerships with participating NFIP communities to collaborate in maintaining up-to-date flood maps and other flood hazard information through the CTP program. Under the CTP program, a community and FEMA work as partners to more efficiently and effectively update flood hazard maps. This ensures that local knowledge about flood problems, local sources of data, and local preferences for study priorities are all incorporated into the process. The CTP program brings funding for eligible activities, such as topographic data generation, hydrologic and hydraulic analyses, Digital FIRM (DFIRM) creation, and others. More information can be found at FEMA's Web site at http://www.fema.gov/fhm/ctp_main.shtm.

FEMA encourages a community to provide more accurate flood data to revise its FIRM. In fact, the Cooperating Technical Partners (CTP) program is a formal mechanism through which communities can cooperate on new flood studies or provide flood data that may differ from FEMA mapping criteria.

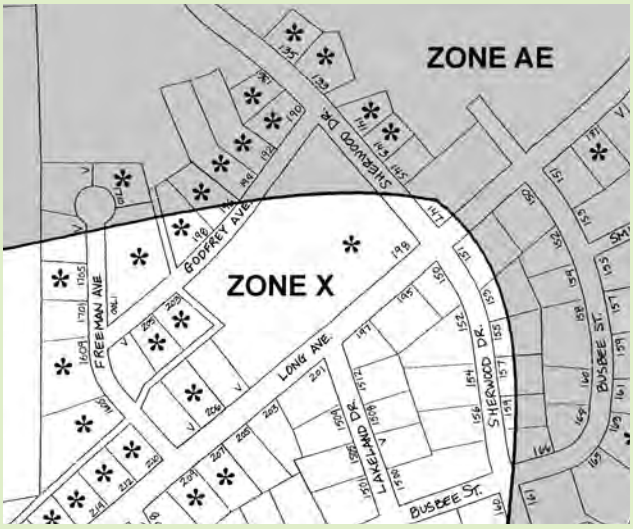
FEMA is working to prepare more new flood studies. Its Map Modernization Program has a goal of helping all communities update their FIRMs by the year 2008. Congress is allocating significant additional funding for these efforts. In other words, under the CTP program, FEMA wants to work more closely with communities to better delineate their flood hazard areas, and under Map Modernization, FEMA is expected to be able to increase its new study effort.

FEMA has also provided guidance and developed software to facilitate flood studies and reduce their cost. *Managing Floodplain Development in Approximate Zone A Areas* can be ordered from FEMA or downloaded from its Web

Conway Remaps after Floyd

Hurricane Floyd flooded places in the **City of Conway, South Carolina**, that were outside the mapped SFHA of the Waccamaw River and its tributaries. The map below shows that many properties in the X Zone were flooded with water over 2 feet deep. Many flooded property owners did not have flood insurance because they were not in the designated SFHA.

Conway reviewed the discharges and elevations from past floods. The chart below summarizes these data, showing that the Hurricane Floyd flood in 1999 had practically the same discharge as the 100-year or base flood used for the city's FIRM. However, the elevation of the flood was 1½ feet higher. There had also been a flood in 1928 with the same discharge and elevation as in 1999.



* *Property where the 1999 flood was over 2 feet on the outside wall of the building.*

V *Properties with a "V" and no address are vacant.*

Waccamaw River at Conway

Date of Crest	Estimated Peak Discharge (cubic feet/ second)	Elevation (NGVD)* (feet)
October 1924	15,400	10.45
September 1928	22,000	12.75
September 1945	15,500	10.55
March 1959	8,800	7.75
July 1961	9,600	8.05
February 1973	9,900	8.35
December 1994	8,630	8.00
September 1996	12,000	9.15
February 1998	14,800	9.60
September 1999	22,400	12.55
Base Flood (modeled)	**22,310**	**11.10**

* National Geodetic Vertical Datum

Conway opted to use the Hurricane Floyd flood elevations for its floodplain management regulations. The area affected by Floyd became the regulatory floodplain. The city subsequently requested a revision to its FIRM in order to allow the flooded properties to become eligible for mitigation funding assistance and to inform future purchasers of property of the true flood hazard.

Flood Hazard Mitigation Plan,
City of Conway, South Carolina (2000)

site. It includes instructions on using the Quick-2 program, which can help calculate a BFE without conducting an expensive on-site flood study.

Permit Requirements

The greatest obstacle to preparing a new flood study is the cost. There is a rationale that says that if someone wants to build in a flood-prone area, he or she should bear all the costs of developing there, including paying for any needed flood data. The NFIP requires that in approximate A Zones (mapped floodplains where FEMA did not provide a flood elevation), anyone who develops more than 50 lots or 5 acres must provide the needed data.

This rationale is appropriate in all flood-prone areas for all sizes of development. Some communities require developers to:

- Identify all streams and watercourses that flow through or adjacent to the property;
- Determine the size of the contributing drainage area; and
- If the drainage area exceeds a certain threshold, provide the BFE (and in some cases delineate a floodway).

An example of this approach is the City of Tulsa, Oklahoma. Tulsa requires all development in drainage areas as small as 40 acres to conduct a study to show the 100-year floodplain and floodway. All areas smaller than 40 acres must have a combination of storm sewer and overland drainage so that a 100-year storm will not cause any building to flood.

In Prince George's County, Maryland, developers are required to delineate the floodplain for streams that drain 25 acres or more. This approach can also be used if the community has identified flood-prone areas of concern, such as those that have been repetitively flooded in the past. If such areas are delineated based on available historical data, developers could be required to conduct a study to produce a regulatory flood elevation before they are permitted to build there.

Lake County, Illinois, regulates many flood problem areas outside the SFHA shown on its FIRM. These include:

- "Flood table lands," areas within 2 feet of elevation of a floodplain for a stream that drains more than 100 acres;
- Depressional storage areas with a storage volume of 0.75 acre-feet or more for the base flood; and
- Non-riverine depressional floodplains and wetlands of any size.

Permit applicants must have an engineer calculate the BFE in these areas. In non-riverine areas, the historic flood-of-record elevation plus 3 feet can be used instead of conducting the detailed study. The full language of the county's Watershed Development Ordinance can be found at http://www.co.lake.il.us/smc/regulatory/wdo/.

Study Standards

Although the FIRM floodplain boundaries are the regulatory boundaries initially provided by FEMA, communities can consider using higher standards when mapping a flood-prone area. This would apply to any of the previous conditions: restudying an existing SFHA, preparing a new study, or requiring developers to prepare regulatory flood data. (Note that a community should modify its ordinance to have the authority to require that these higher study standards be used.)

The most common higher study standard is known as future-conditions hydrology. Under FEMA mapping standards, the flood elevations on FIRMs are based on land use conditions existing at the time of the study (which may have been a decade or more in the past). If significant development occurs in the watershed, the hydrology (i.e., how much water comes from the watershed) will be outdated and will likely understate the true flood hazard.

To prevent studies from becoming outdated as new development alters the watershed and the hydrology, communities can take two approaches: (1) require that new developments in the watershed include storage basins to store the excess stormwater, or (2) conduct studies that are based on future watershed conditions. Many communities use both approaches. Stormwater storage basins are discussed on page 4-14.

Mapping based on future watershed conditions is especially useful where a community does not have regulatory authority over the watersheds outside its corporate limits. One of two common approaches is used:

- Assume that the watershed is developed according to a long-range land use plan; or
- Assume that runoff comes from a fully urbanized watershed.

Future-conditions hydrology and other higher standards will usually result in larger floodplains and higher flood elevations than are shown on the FIRM. Using such data has several benefits:

- New construction will be better protected against flood damage;
- There will be fewer requests for FIRM revisions;
- Flood insurance rates will be lower for new buildings as a result of higher standards; and
- The community can receive CRS credit.

Anne Arundel County, Maryland, has a "48-inch pipe rule," which requires that the 100-year floodplain be delineated for a stream if a 10-year ultimate land use discharge cannot be conveyed within a 48-inch reinforced concrete pipe at the natural ground slope.

Anne Arundel County, Maryland, Floodplain Ordinance

Land Use Regulations

Once the flood-prone areas are shown on a community-adopted map, the community can use several techniques to prevent new development in those areas from being subject to flood damage and from aggravating existing flood problem(s). Three general approaches are covered in the rest of this chapter:

- Land use regulations to guide development away from the flood-prone areas;
- Regulations on new infrastructure, such as drainage systems; and
- Regulations on construction of individual buildings.

There are two basic tools to regulate the use of land: a land use plan and a zoning ordinance. These tools designate where low-, medium-, and high-density residential development and industrial and commercial development should go. These tools are

used early in the development process, and they should require or at least encourage development to avoid flood-prone areas.

Planning and zoning regulations should allow only those land uses that are compatible with the natural conditions of the land. For example, in areas where there is no infrastructure for sanitary sewers, the regulations should specify a lot size large enough for the soil type to accommodate the drain field needed for a septic system.

Use of the land should be tailored to match the land's hazards, such as reserving flood-prone areas for parks, greenways, golf courses, backyards, wildlife refuges, wetlands, natural areas, resource conservation areas, or similar compatible uses. Planning and zoning regulations should allow developers flexibility to arrange improvements on a parcel of land so they can reach their development objectives and avoid the hazardous areas at the same time. One way to do this is through the planned unit development (PUD) approach discussed on page 4-10.

Plans

Most communities use comprehensive plans or land use plans to guide future development. Although it usually has limited authority, the plan sets out what the community would like to see happen. It guides other local measures, such as capital improvement programs, zoning ordinances, and subdivision regulations.

Plans can reduce future property damage by specifying land uses of open space or low density development within areas known to be flood-prone. Unfortunately, flooding or other natural hazards are not always considered when many communities prepare their plans. But in more and more instances, community plans call for reserving flood-prone areas as open space. One example is St. Charles, Illinois (see facing page).

A capital improvement plan will guide a community's major public expenditures for 5 to 20 years. Capital expenditures may include flood control projects and drainage modifications; acquisition of open space in flood problem areas; and extension (or withholding) of sewers, water lines, and other public services into flood-prone areas.

As a rule of thumb… wetlands, floodplains, and slopes… take first priority for inclusion in the designated open space, as they represent highly sensitive environmental resources that are generally considered to be unbuildable in a legal sense, in a practical sense, or for reasons of common sense.

Arendt (1996)

Zoning

A zoning ordinance regulates development by dividing a community into zones or districts and setting development criteria for each zone or district. Zoning is the primary tool for implementing a comprehensive plan's guidelines for how land should be developed. Zoning ordinances can limit development in flood-prone areas, such as reserving the SFHA for agricultural uses.

A zoning ordinance can also require larger lots or lower densities in areas with flooding, poor soils, or known drainage problems. This requirement helps to ensure that the builder can locate a suitable place on the lot for the structure and reduces the total number of people who will be exposed to the hazard.

On large lots, a lower percentage of the area will have impervious surfaces, and it will be easier to preserve natural storage depressions.

St. Charles' Comprehensive Plan

The Comprehensive Plan of the **City of St. Charles, Illinois**, was adopted in 1996. Three chapters are devoted to natural development factors: geological conditions, hydrological conditions, and open space. The introduction to this section states:

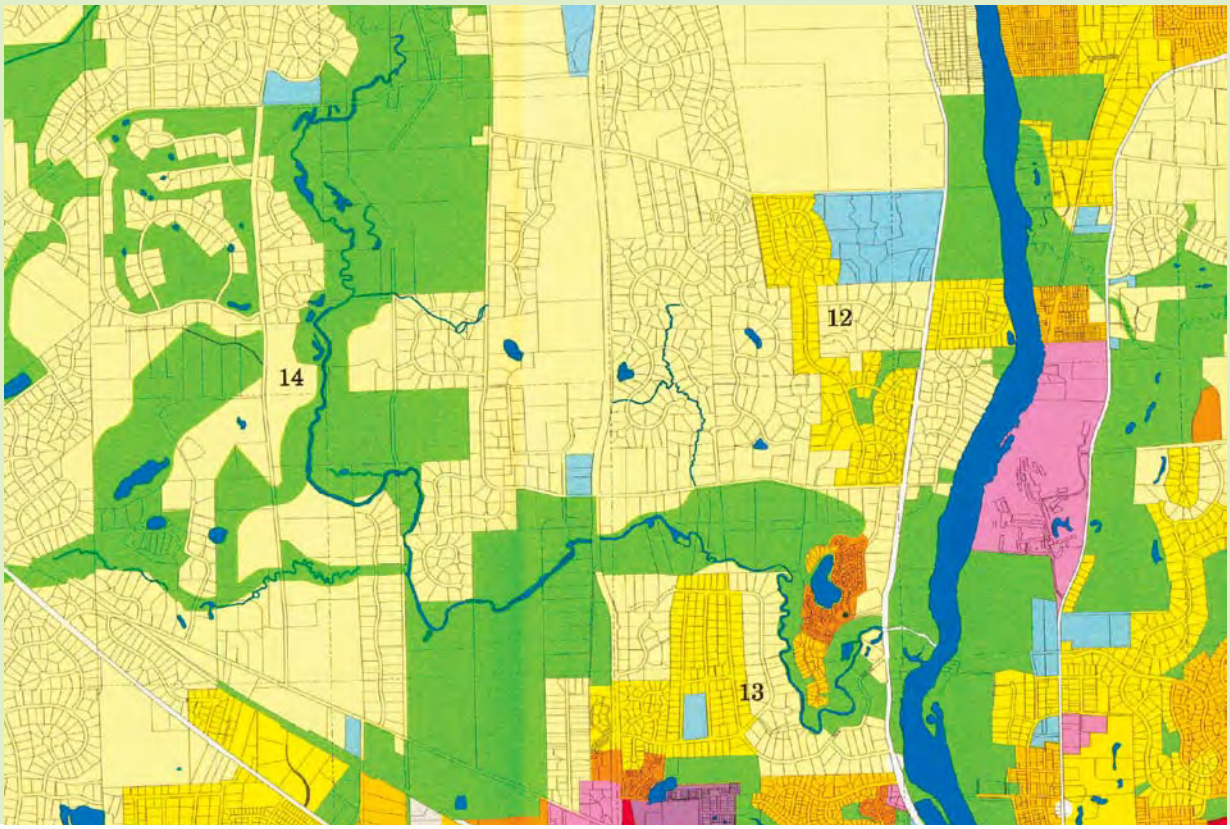
> *Many of today's environmental problems result either from past ignorance of the impact of man's actions or insufficient attention to the importance of natural systems.... An understanding of this information will enable the community to build and maintain a harmony between development and nature.*
>
> Comprehensive Plan, page 5-2.

The plan recommends that permit applications be required to include a soil survey and development proposals be reviewed by the Soil and Water Conservation District for their impact on natural features.

The chapter on hydrological conditions notes that "One of the best ways to prevent losses from flood damage is to protect floodplains from development" (page 6-6). It then describes the beneficial uses of floodplains, such as outdoor recreation, wildlife habitat, and scenic beauty enhancement. This chapter includes a map showing all the lots and floodplains in the city.

The chapter on open space and recreation builds on this goal to preserve floodplains. It identifies the benefits of preserving and restoring natural areas and the special attention that should be paid to the Fox River waterfront. There is also a section on continuity of open space, which recommends corridors to protect linear features (like streams) and to link parks and other sites. Pursuing these concerns not only makes for a more pleasant and safe environment to live in, it also enhances the city's image and character.

All of these concerns come together in one of the most important parts of the Plan, the Future Land Use Map. As seen in the excerpt below, the city intends to overlap the green open space areas with the blue watercourses and their floodplains.



In Activities 420 and 430LD (Open Space Preservation and Land Development Criteria), the CRS encourages and provides credit for:

- Regulations that preserve floodplains as open space;
- Regulations that encourage developers to set aside floodplains from development; and
- Floodplains zoned for lower density development (less than one building per acre).

An increasing number of communities have adopted the PUD approach. The PUD approach allows adjustment of site design standards and land use densities to preserve open space and/or flood-prone areas from development. In return, the developer is allowed to have a higher density in the flood-free area (see example on facing page).

Standards for Subdivisions

Although land use plans and zoning ordinances can help steer development away from flood-prone areas, some development inevitably will occur in those places. This guide recommends that communities use two types of regulations for such development: (1) ensure that the infrastructure is free from flood damage and does not aggravate flooding, and (2) ensure that individual buildings are protected from flood damage.

"Infrastructure" is a term that encompasses the public works and utilities that serve development. These include the streets, water lines, drainage system, storm and sanitary sewers, and subdivision layout. The standards recommended here usually would be incorporated into the community's subdivision regulations. Four provisions of subdivision regulations are reviewed in this section:

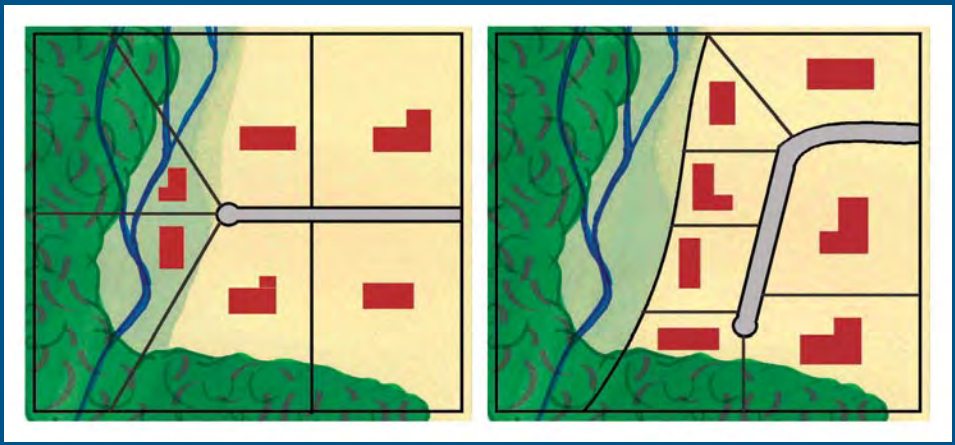
- Designing subdivision layouts to keep infrastructure and buildings out of flood problem areas;
- Setting buildings back from the source of flooding through buffers;
- Controlling stormwater runoff; and
- Incorporating the "green infrastructure" approach.

Subdivision Layout

Zoning ordinances dictate the density of development in each zoning category (for example, a zone of R2 may require a minimum lot size of 0.5 acre). Typically, a developer will divide the parcel evenly, so that a 10-acre parcel will have 20 evenly spaced half-acre lots. The concept of PUD is illustrated on the following page. Subdivision developers should always be encouraged to vary from the traditional approaches if by doing so they can avoid building in the flood-prone areas.

Cluster development is an attractive redevelopment option for developers because the cost of land clearance, site preparation, and infrastructure is reduced. Sometimes, the community will allow higher densities than permitted under the regular zoning district as an incentive to keep new construction out of flood-prone areas.

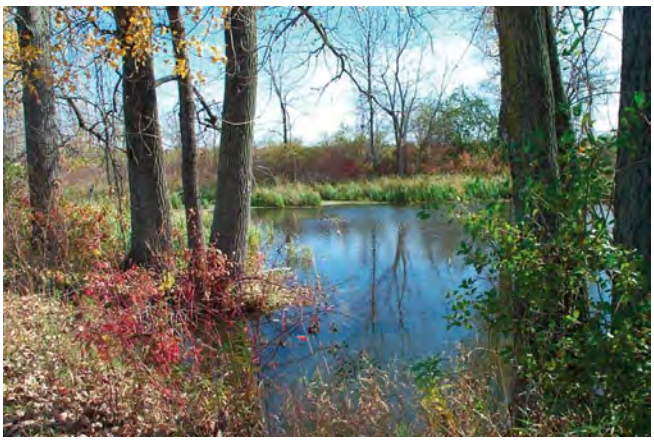
PUD: In the standard zoning approach (left), the developer considers six equally-sized lots without regard for the flood hazard. Two properties are subject to flooding and the natural stream is disrupted. On the right is an alternative, flexible, PUD approach. The floodplain is dedicated as public open space. There are seven smaller lots, but those abutting the floodplain have the advantage of being adjacent to a larger open area. Four lots have riverfront views instead of two. These amenities compensate for the smaller lot sizes, so the parcels are valued the same. The developer makes the same or more income, and the future residents are safer.



Buffers

If the subdivision layout does not keep entire lots out of the flood-prone area, buffers can help minimize the amount of development exposed to flooding. Buffers require certain areas to be kept open and free of development.

A buffer is typically a setback of a specific distance, such as 25 or 100 feet, from a channel, floodway, wetland, or other water feature. In that area, no cutting, clearing of ground cover, or alteration of the natural features is allowed, but the rest of the lot can be regraded and built on. In the State of Maryland, for example, a 25-foot buffer is required next to all wetlands.



Lake County, Illinois, Stormwater Management Commission

Buffers protect natural areas and filter runoff into streams and ponds. They have a spin-off benefit of keeping buildings away from sources of floodwater.

Under such a restriction, buffers help:

- Preserve the natural habitat adjacent to the water;
- Improve the visual appearance of the waterway;
- Reduce the potential for disruption or erosion of channel banks; and
- Filter runoff to the stream, improving water quality.

Buffers are also a best management practice (BMP) recognized under the National Pollutant Discharge Elimination System (NPDES). For further information on NPDES, see page 8-5.

Buffers Help Manage Stormwater and Protect Wetlands

The south suburbs of the Chicago area are subject to several types of flood problems. The South Suburban Mayors and Managers Association initiated a South Suburban Stormwater Strategy to develop programs to reduce the area's exposure to localized flooding. One of the resulting projects was a model ordinance that combined floodplain management, stormwater management, and wetlands protection measures. Section 11 of the *Model Stormwater and Floodplain Management Ordinance* of the South Suburban Mayors and Managers Association has the following buffer language:

11.1. Buffer Areas Required. Buffer areas shall be required along all streams, lakes, waterways, channels and wetlands, except for the following:

(a) Roadside ditches;
(b) Existing excavated stormwater storage facilities;
(c) Borrow pits and quarries;
(d) Leveed waterways; and
(e) Improvements to existing public roads and utilities.

11.2. Buffer Area Dimensions

11.2.1. Linear Buffers. Linear buffers shall be designated along both sides of all streams and natural channels. A minimum buffer of thirty feet on each side of the channel shall be provided.

11.2.2. Water Body Buffers. Water body buffers shall encompass all lakes, wetlands and other non-linear bodies of water. A minimum buffer of thirty feet on each side of the channel shall be provided.

11.2.3. Exceptional functional value wetlands shall have a minimum buffer of one hundred (100) feet.

11.2.4. In areas having State or Federal threatened and endangered species present or for Illinois Natural Area Inventory Sites, buffer widths may be modified to meet the terms and conditions specified during consultation with the Illinois Department of Natural Resources (DNR) or United States Fish and Wildlife Service, pursuant to State and Federal laws and regulations.

11.2.5. The buffer area for all Waters of the United States shall extend from the ordinary high water mark. The buffer area for wetlands shall extend from the edge of the delineated wetland. A property may contain a buffer area that originates from the Waters of the United States on another property.

11.2.6. Buffer averaging may be allowed by the [title of permit official], provided the buffer width is at least half of the buffer width required by this ordinance or the minimum width required by a Corps of Engineers permit, whichever is wider.

11.3. Buffer Requirements

11.3.1. Features of the stormwater management system may be within the buffer area of a development.

11.3.2. Access through buffer areas shall be provided, when necessary, for maintenance purposes.

11.3.3. Preservation of buffer areas shall be provided by deed or plat restriction.

11.4. Allowed Uses in Buffer Areas

11.4.1. All buffer areas shall be maintained free from development except for the following uses:
(a) Passive recreation, including pedestrian, bicycle, or equestrian trails.
(b) Construction and maintenance of utilities and stormwater facilities.

11.4.2. Structures and impervious surfaces related to recreational facilities, such as trails and paths, may occupy a maximum of twenty (20) percent of the buffer surface area, provided the runoff from such facilities is diverted away from the Waters of the United States or such runoff is directed to enter the buffer area as unconcentrated flow. Boat docks, boathouses and piers shall be allowed and count as a structure when calculating percent of impervious area.

11.4.3. Buffer areas hydrologically disturbed by allowing construction or as part of a revegetation plan shall be revegetated using the *Native Plant Guide for Streams and Stormwater Facilities in Northeastern Illinois,* (NRCS, et al.) as a minimum standard.

Example buffer regulations are on the facing page.

Enforcing buffer requirements is very important. Although many communities have excellent enforcement programs while construction is taking place, it must be remembered that permanent buffers and easements need to be established and kept open forever. Many property owners are not aware that 10 years after the house has been built, they still cannot build a shed in the easement or chop down trees in the buffer area.

Stormwater Management

Development activities outside the flood-prone area can significantly affect drainage and flooding. Stormwater runoff is increased when natural ground cover is replaced by urban development. To protect properties from runoff, developers "improve" the local drainage system by putting parts of it underground in storm sewers and building ditches to carry larger surface flows.

This combination of increased runoff and drainage system modifications may increase flooding, overload the downstream drainage system, cause erosion, and impair water quality. Today, most communities have stormwater management requirements designed to minimize the adverse impacts caused by urban development. Instead of building larger pipes and ditches to hurry the water away from a development (and onto someone else's property), subdivision ordinances have standards to manage stormwater.

Stormwater management encompasses four objectives:

- Manage stormwater runoff so new development is not damaged during a major storm;
- Prevent new development from diverting surface flows onto other properties;
- Prevent new development from increasing the peak flows to the receiving drainage system; and
- Maintain or improve the quality of the water in the system.

In Activity 450 (Stormwater Management), the CRS encourages and provides credit for regulations that require developers to detain or retain excess stormwater runoff and that require stormwater management facilities to include features that improve water quality.

To meet these objectives, a community's subdivision or other development regulations should have stormwater management standards. These usually include the following:

- Locate building sites on higher ground or on human-made building pads so stormwater will run away from the building, into swales, or into the street.
- Design swales along lot lines to carry water to drainage easements, the street, or nearby ditches (see the Orland Hills illustration on page 4-18).
- Design storm sewers to carry the runoff from smaller storms without causing street flooding. Traditionally, the national standard is for storm sewers to carry the 10-year storm. Recently, communities are finding that older estimates of the 10-year storm understated the true hazard, so they are addressing larger storms.

- Ensure the infrastructure can handle larger storms without damaging buildings. For example, the streets or a defined overflow path can be designed to handle the runoff that will not fit in the storm sewers, provided that emergency access routes are established and maintained.
- Design parking lots, rooftops, streets, or storage basins to hold the runoff and release it downstream over time, keeping the peak flow to a level at or below the peak flow that existed under the pre-development conditions.
- Incorporate water quality provisions in the storage basins. For example, if water is held for a period of time, sediment and other pollutants can settle to the bottom, and the released water will be cleaner than when it entered the basin. These techniques can also help meet the community's NPDES goals.

Increasingly, communities are incorporating existing natural features into their stormwater management plans and including water quality aspects in their drainage system design. There is a move away from storm sewers, which are expensive and have limited capacity, toward open swales and grassy ditches, which can carry larger flows and have the added advantage of filtering and cleaning the water.

Green Infrastructure

As noted at the beginning of this section, infrastructure is a term that encompasses the public works and utilities that serve development. Typically, streets and drainageways are thought of as essential public features that must be included in all new subdivisions and other developments.

The green infrastructure concept views natural areas as another form of infrastructure needed both for the ecological health of an area and for the quality of life that people have come to expect. Many communities have realized that open space and green areas are just as vital to urban development as are water and sewer lines.

Green infrastructure can include parks, buffers along waterways, greenways, farms, backyards, residential landscaping, and urban gardens. These areas can have multiple uses. Not only do they protect natural functions and habitat, but they also act as stormwater storage areas, water conveyance areas, and runoff filters. They can be excellent parks, trails, and recreational features that increase the value of the properties near them.

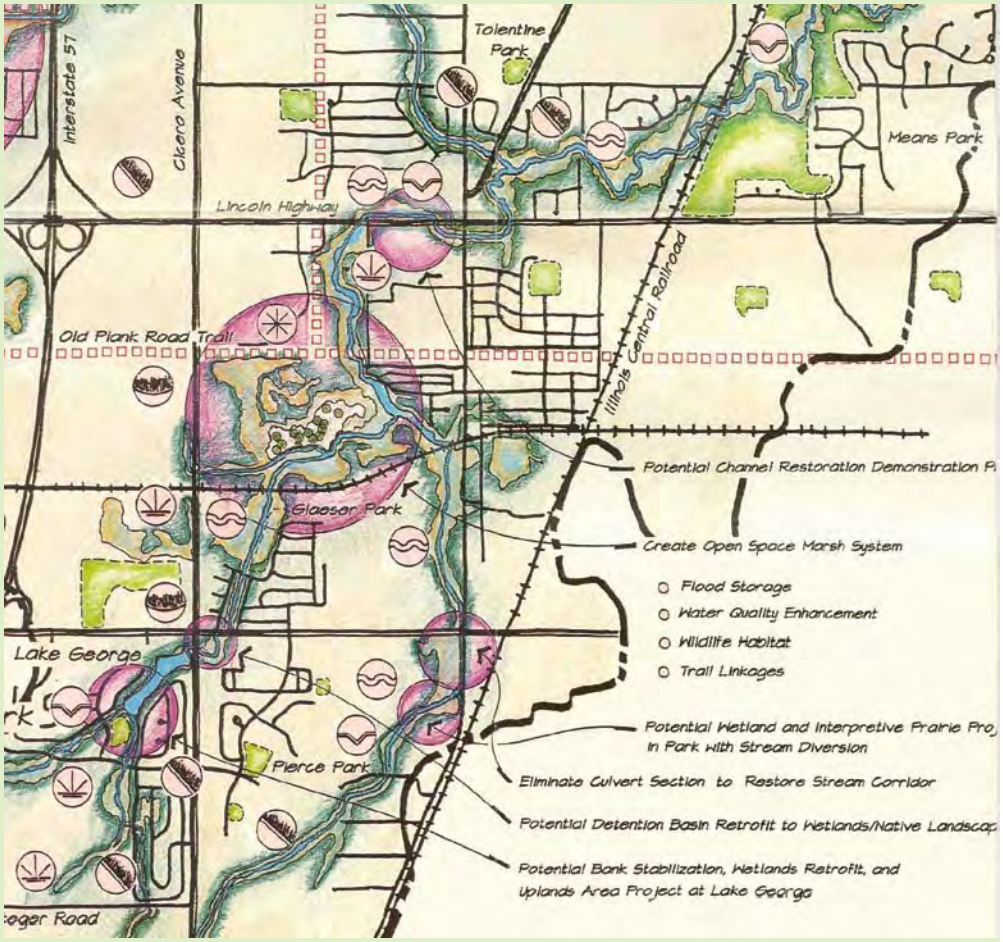
The Maryland Department of Natural Resources is working to identify those undeveloped lands that are most critical to the State's long-term ecological health. These lands, referred to as Maryland's green infrastructure, provide the natural foundation needed to support diverse plant and animal populations, and enable valuable natural processes like filtering water and cleaning the air to take place. Identifying and setting priorities for protection of the green infrastructure is an ongoing process.

A description of Maryland's green infrastructure, including county-by-county maps, can be found at http://www.dnr.state.md.us/greenways/gi/gi.html.

Floodplain Regulations

Every community in the NFIP has floodplain management regulations. These regulations require that the lowest floor of any new or substantially improved residential building be elevated at or above the BFE. Nonresidential buildings can be elevated or floodproofed.

Stormwater Management in the Butterfield Creek Watershed



A study by the Natural Resources Conservation Service in the 1980s concluded that if all development in Illinois' Butterfield Creek watershed were required to construct storage basins, flood heights and erosion would still increase because of the loss of natural water storage areas. Faced with repetitive floods, streambank erosion, and other problems, the communities in the watershed formed the Butterfield Creek Steering Committee to look at the causes of the problems and possible solutions.

It was concluded that the existing open areas in the upper reaches of the watershed must be preserved in order to provide the needed natural stormwater storage. To do this required a great deal of cooperation between the downstream and upstream communities. Working together, the Steering Committee prepared a Vision Plan, sought funding support, and received cooperation and money from a variety of agencies.

The Vision has regulatory measures, corrective actions, and a strong recreational element. A key part is a master floodplain and stormwater management model ordinance that all the communities adopted. Developers are encouraged to preserve marshes and wetlands for their flood storage capacity and to enhance wildlife habitat and recreational opportunities. Other storage areas have been purchased and turned over to park and forest preserve districts.

Why not enforce these standards in known problem areas that are outside the SFHA designated on the FIRM? The standards work in the official floodplain, and they can be just as effective in other flood-prone areas. The discussion in the beginning of this chapter describes how these other areas can be mapped. The community needs only to adopt the new map as part of its floodplain management ordinance.

A typical floodplain management ordinance includes the sections listed below. The appropriate amendments are shown in red. Additional studies for other areas can also be referenced. Note that any revision of the ordinance should be made only after reviewing the change with the State or the FEMA Regional Office to ensure that it complies with the NFIP.

Section __. Lands to which this ordinance applies

This ordinance shall apply to all the special flood hazard areas (SFHAs) as shown on the Flood Insurance Rate Map of the City of Floodville. The SFHA shall also include the regulatory floodplain along Oliver Creek as shown on the Oliver Creek Flood Study.

Section ___. Basis for establishing the areas of special flood hazard

The SFHAs are identified

(1) by FEMA in the Flood Insurance Study for the City of Floodville, dated January 1, 1995, and

(2) by the Oliver Creek Flood Study conducted by Lightning Engineers, dated June 23, 2004,

with accompanying maps and other supporting data adopted by reference and declared to be a part of this ordinance.

Other sections of the floodplain management ordinance adopt the regulatory BFE and floodway. Those sections would be similarly amended. If the new area to be regulated has not been delineated by a detailed study and there is no calculated BFE, other techniques can be used to set a regulatory flood elevation, as described earlier in this chapter.

One key factor in the NFIP floodplain management regulations is that they cover existing buildings as well as new ones. If an existing building in the SFHA is to undergo a substantial improvement (i.e., the cost of the improvement or addition equals or exceeds 50 percent of the value of the building), then the building must be brought into compliance with the floodplain management regulations.

If the building is damaged (by any cause) so that the cost to repair the structure to its pre-damaged condition exceeds 50 percent of the value of the building, then it is considered to be substantially damaged. As with a substantial improvement, a substantially damaged building must be brought into compliance with the floodplain management ordinance.

There is a special funding provision in the NFIP for insured buildings that have been substantially or repetitively damaged by a flood. Increased Cost of Compliance (ICC) coverage provides for the payment of additional funds (up to $30,000) to help pay for the cost to comply with community floodplain management ordinances after a flood in which a building has been declared substantially damaged or repetitively damaged.

A community that is serious about reducing its repetitive localized flooding problems would benefit by learning the details of ICC coverage. ICC currently is available to

properties in the SFHA. After regulations pursuant to the Flood Insurance Reform Act of 2004 are published, there will be ways for properties outside the SFHA to benefit from this provision, too. The community should discuss ordinance language with the FEMA Regional Office. Proper enforcement and an informed property owner can greatly facilitate the claims process and help provide funding to mitigate the risk to the flood-prone building.

Site Drainage

Inadequate site drainage is a common cause of flood damage to buildings. Conveyance of stormwater away from a structure is critical to prevent overland flooding of the structure. It can also help prevent basement flooding due to high groundwater elevations.

Three regulatory approaches can prevent future problems caused by inadequate site drainage:

- Require new subdivisions to account for drainage from each lot;
- Require individual buildings to be elevated; and
- Enforce drainage easement provisions.

Subdivision Design

When a subdivision is designed, a separate drainage plan should be prepared and reviewed by the community's engineers. It should include the stormwater management provisions discussed above to ensure that excess surface flows are properly handled.

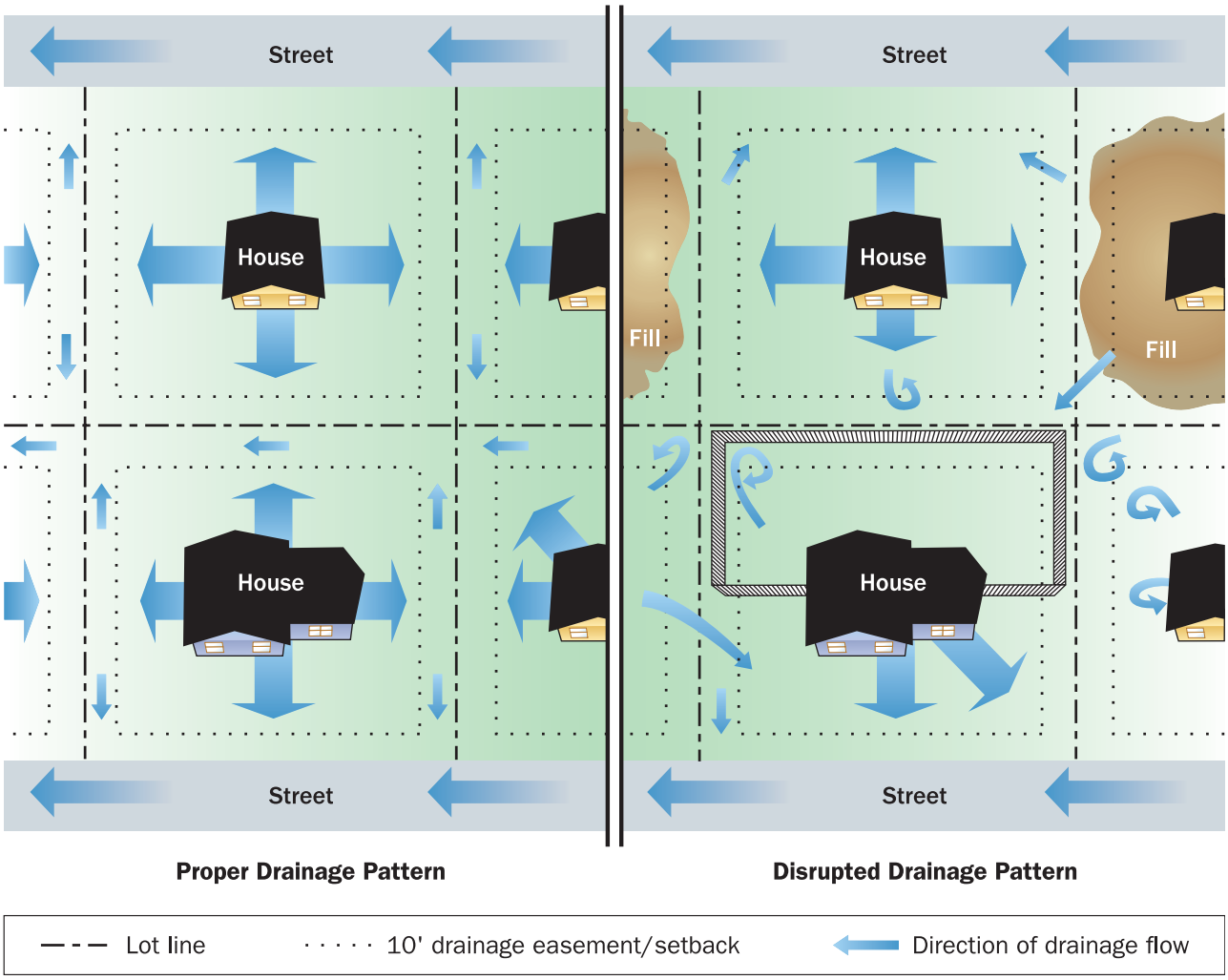
A subdivision or other development proposal may also include a separate drainage or grading plan. Individual lots should be designed to direct the flow of surface water away from the building. Typically, the developer must provide a building pad on each lot. The top of the pad must be at a certain elevation or a set number of feet higher than the edge of the lot.

Most subdivision regulations require utility or drainage easements to be set aside as part of the subdivision plat. Such easements are 5 or 10 feet inside the property line and carry restrictions that prohibit construction or obstructions. Stormwater flows from the building pad to the easements and into the street or a drainageway. An example of a properly designed drainage pattern is shown on the left side of the illustration on the following page.

Building Elevation

Some homes have been built at grade. In very flat areas, the first floor may be only a few inches higher than the ground. When it rains, the water does not drain away. Instead, it ponds or flows into these low structures.

This has been a significant cause of repetitive flooding problems, especially in the South where, over the last 50 years, slab-on-grade foundations replaced the earlier method of building houses on piers or crawlspaces. Under the old construction



The Village of Orland Hills, Illinois, found out the hard way why it is important to keep drainage easements open. Some of the problems that occurred are described in the sidebar on Orland Hills in Chapter 2. This graphic is based on the Village's 1995 *Flood Protection Plan* that explained the problem to the public and helped launch more public information and enforcement activities to keep the easements open. The number of violations and drainage complaints has steadily decreased over the years since the Plan has been implemented.

method, localized floodwaters flowed under the first floor, causing no damage. With the more recent construction techniques, such flooding goes over the slab and into the first floor (see the left side of the St. Tammany Parish example on the facing page).

There are three typical approaches to ensure that new buildings are not built too low for the circumstances:

- Require positive drainage away from the building. This is a standard provision in the model building codes. Section 1803.3 of the International Building Code has such a requirement, for example, so this provision may

St. Tammany Parish, Louisiana

French & Associates

St. Tammany Parish, Louisiana, had many homes built close to grade in very flat areas. Heavy rains caused on-site flooding and did not drain away quickly. Homes like the one on the left were frequently flooded. In response, the Parish adopted a requirement that lowest floors be at least 6 inches above the street. Site plans for new construction combine elevation of the building pad with improved drainage, so local drainage is not a flooding problem in new subdivisions (as shown on the right).

already be part of the community's regulations, but that does not mean that it is always adequately enforced.

- Require the lowest floor of new buildings to be 1 or 2 feet higher than street level (see the right side of the St. Tammany Parish example above).
- Require the permit applicant to submit a site plan that accounts for local drainage from and onto adjoining properties and that protects the building and adjoining properties from local drainage flows.

In Activity 450 (Stormwater Management), the CRS provides credit for all three approaches to protect new buildings from local drainage problems.

NFIP/CRS

Drainage Easements

Most lots have utility or drainage easements that set aside the area that is 5 or 10 feet inside the property lines. These easements are designed to carry surface water away from the buildings and to the street, storm sewer, or other drainage facility (see illustration of drainage patterns on facing page). Easements must be kept open to do their jobs. Unfortunately, many property owners do not realize (or forget) that the easements exist or why they are needed.

When people build fences, garages, sheds, or swimming pools, or plant trees in the easement, the drainage pattern is disrupted and surface water will be pushed onto other properties. The photograph on the following page shows how a local drainage system can become obstructed when property owners forget to keep their easements open.

French & Associates

When this subdivision was constructed, the backyards were open. Over the years, fences along the lot lines have disrupted the drainage system. Stormwater would flow away faster if these obstructions were removed.

For easements to work, the easement restrictions must be enforced by the community. Property owners must be reminded to obtain permits for sheds, swimming pools, fences, and other structures that can alter the ground surface. Permit officials need to check the easements before issuing a permit and conduct on-site inspections for all projects, no matter how small, to ensure that they do not encroach on the easements.

A public information program can be an effective tool to help enforce these regulations. Property owners who are aware of and understand the need for keeping easements open are less likely to obstruct them and are more likely to advise local officials when they see potential problems. As noted on page 2-6, Orland Hills used a combination of regulations, public information, and drainage modifications to reduce its drainage problems.

Where to Get Help

The following agencies can help with mapping regulatory floodplains:

- FEMA
- U.S. Army Corps of Engineers
- Natural Resources Conservation Service
- State Department of Natural Resources

The following agencies can provide assistance in reviewing the community's regulatory standards and setting new ones:

- FEMA
- State National Flood Insurance Program Coordinator

Training and references on these topics can be found through:

- FEMA
- Association of State Floodplain Managers
- State and regional associations of floodplain managers
- American Society of Civil Engineers

Additional resources are listed in Appendixes A and B.

Public Information and Awareness

5

One of the most effective long-term ways a community can cope with localized flood problems and prevent future ones from occurring is by educating its residents about why such problems occur outside the Special Flood Hazard Area (SFHA) and what they can do to help prevent them.

A community can choose from numerous avenues to build awareness of and knowledge about localized flooding and remedies. The following public information activities serve community residents, property owners, insurance agents, lenders, and real estate agents by advising them about the flood hazard, flood insurance, ways to prevent or reduce flood damage to buildings, and the natural benefits and functions of floodplains.

Answer Questions

Virtually all communities provide residents with information about flooding and preventive measures if they ask for it, perhaps when they inquire whether a property is in the floodplain or they request an elevation certificate. National Flood Insurance Program (NFIP) communities are required to make public documents available, such as the current Flood Insurance Rate Map (FIRM), or permit records, so that residents can consult them as needed.

Communities with drainage problems or other types of localized flooding should be ready to explain that the issue is more complicated than simply being inside or outside the SFHA, or 100-year floodplain. The community's program for providing map information could be expanded to offer information about low-risk areas as well as about the 100-year flood. Local staff should provide information about all known flood hazards, including those not mapped on the FIRM.

The local staff should be prepared to provide information and advice about:

- Safety measures that can be taken by individuals, property owners, drivers, and passengers in automobiles;
- Flood risk both inside and outside the SFHA;

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Before a permit is issued, permit officials should review all information known about drainage and local flooding problems in the area.

- Retrofitting techniques to make buildings safer;
- Building techniques and standards (or regulations, if applicable) to make a new structure resistant to shallow flooding (such as placing utilities above the flood level);
- Sources of help in taking action to reduce flood damage;
- The availability of flood insurance and insurance for sump pump failure and sewer backup, even outside the floodplain; and
- Special flood-related problems in the community, such as streambank erosion or subsidence.

A community's technical staff—building department personnel, code enforcement officers, public works staff—have expertise and experience in construction. Although they cannot assume responsibility for the design or construction of a property owner's project, they can answer inquiries about flood protection measures, point people in the right direction, explain what won't work, and identify licensed companies or experienced contractors who can do the work. Some building department or public works staff, such as those of the St. Louis, Missouri, Metropolitan Sewer District, visit properties on site and offer suggestions.

Credit is provided by the CRS under Activity 360 (Flood Protection Assistance) for visiting a problem site and giving the property owner advice appropriate for the situation, such as retrofitting techniques and names of qualified contractors.

Provide Resources for the Public

People who set out to learn more about localized flooding and its possible remedies are far more likely to follow through if they find resources within the community that help them with their mission. A community can help by making sure that various types of information about local flooding are accessible to the public.

The local library is a logical place to start. A community could have a special section in the library that includes materials on its local flooding history, flood control and drainage projects, success stories, guidance for homeowners, flood maps, and natural resources associated with the streams, such as wetlands or wildlife habitat. Interested property owners can read or check out handbooks or other publications that apply to their situations or log on to the Internet to search for helpful Web sites.

Some communities participating in the Community Rating System (CRS) already have documents on flood risk available in the library, and get CRS credit points for doing so. It would be simple to augment this collection with specific information about local flooding within the community, action to take, and experts to contact for advice.

A community can display its maps showing flood risks at various places in town—the city hall, public works offices, library, or other visible locations. If additional information (beyond what is displayed on the community's FIRM) is shown on these maps, the residents are more likely to become interested in flooding problems and remedies. The maps should show not only the 100-year floodplain but also other features relevant to local flooding, such as low-risk flood areas, drainage problems, natural zones along waterways, or wetlands. They could incorporate aerial photographs that show recognizable buildings or landmarks, information about additional hazards (such as landslides); flooding outside the SFHA; natural habitat and parks; or zoning and development regulations.

Under Activity 350 (Flood Protection Information), the CRS credits making references and technical information available through the community's library and/or Web site.

Not only can the community Web site be a research tool, but it also can be a quick way to stimulate interest or convey ideas to Internet surfers. The Web site could include the same sorts of information housed in the local library, but with the advantage of being displayed in a more attention-getting format. It is not difficult to provide links on the community's Web site to many different sources of information, both public and private, about floods, flood insurance, property protection, and other ways of coping with local flooding.

- Mecklenburg County, North Carolina, has an interactive Web site that allows people to look up their flood zones, as well as obtain educational information (http://maps.co.mecklenburg.nc.us).
- The Colorado Foundation for Water Education has an extensive collection of articles, educational materials, and links to other sources (http://cfwe.org/SchoolPrograms/).

- The city Web site for Fargo, North Dakota, has local information, flood maps, links to the flood-related collection of North Dakota State University, and to State and Federal agencies and organizations (http://www.ci.fargo.nd.us/floodemergency.htm).
- The Federal Emergency Management Agency (FEMA) Web site has a wide array of helpful information geared toward the public.
- The Louisiana State University Extension Center has an extensive flood Web site, a link to the national Extension Disaster Education Network, and online shopping options for retrofitting products, contractors, professional services, and examples of installations (http://www.louisianafloods.org).

A community could also provide a mapping Web site, available to the public. This can serve several purposes, from enabling users to determine their FIRM zone and other property information to displaying the areas that perhaps are not mapped on the FIRM but that the community considers prone to localized flooding. This can be automated through the community's geographic information system (GIS), if it has one. Users who locate their properties in localized flooding areas could then be offered links to other information appropriate to that type of flooding. Palo Alto, California, has a Web site that lists all flood-prone properties in the city, and allows users to see current stream levels at certain monitoring sites (http://www.city.palo-alto.ca.us/cgi-bin/floods.cgi).

The annual mailing to owners of flood-prone property has targeted the people who need to have this information. … Connecting with the local Association of Realtors® has also heightened awareness.

Linda Wheeland
Sangamon County, Illinois

Deliver Flood Information

Instead of waiting for residents to try to find out about localized flooding and its remedies for themselves, a community can reach out in various ways to its residents, businesses, and property owners to help them become aware of and concerned about flood problems and what they can do to protect themselves and their property. This is also a way of letting people know what the community itself is already doing to combat nuisance flooding and drainage problems.

Such efforts on the part of local government or community groups are often called "outreach projects," and they can take almost any form imaginable. Outreach projects are designed to encourage people to seek out more information, take steps to protect themselves and their property, and help them understand the natural processes and benefits of flooding.

Credit is provided by the CRS under Activity 330 (Outreach Projects) for different types of projects designed to inform people about the flood hazard, about flood protection measures, and about the availability of flood insurance. The special publication, *CRS Credit for Outreach Projects,* includes many examples of things that communities have done.

Special outreach projects can be undertaken to reach residents subject to local flood problems, or outreach projects that are underway or ongoing can be expanded to specifically target those people and their particular needs. For example, many communities do an annual mailing to owners of property in the floodplain, reminding them of their flood-prone location, the availability of flood insurance, and steps they can and should take to protect themselves. Residents outside the SFHA but still subject to flooding could be added to this

mailing and/or an insert tailored to localized flooding could be included in their mailings.

Any of the topics discussed in this guide could be included in outreach projects to residents subject to localized flooding, such as measures to protect a property from flood damage (retrofitting, grading a yard, correcting local drainage problems, moving furniture, using sandbags) and drainage system maintenance (rules against dumping in stream channels, how to report violations, and why it is important to maintain the drainage system).

- **Brochures or flyers** with pertinent flood information can be mailed directly to flood-prone properties, displayed in public places, enclosed in utility bills, or distributed door-to-door by scouts or other service groups. This is a good way to reach the people who need to know, because it can be done only in those neighborhoods subject to localized flooding.
- **Presentations** can be made by community staff or other experts to neighborhood associations, civic groups, or business organizations.
- **Signs** posted in appropriate places in town can show the height of the water during previous floods, or remind residents that a storm drain leads to the river.
- **Media packets** delivered to local radio and television stations compile basic flood facts, information about protective measures, names of local experts willing to be interviewed and/or quoted, and sound bites to help the media convey accurate, helpful, and straightforward information, especially during flood or hurricane season.
- **Displays** can be set up in public buildings showing maps of flood-prone neighborhoods, historical flooding, photographs of houses that have been retrofitted, and other information. This can be expanded to a booth for special events in shopping malls, staffed by a person who can answer questions.
- **Awareness campaigns** spread the word throughout the whole community, and some can be tailored to localized flooding problems. For example, the Turn Around Don't Drown™ national campaign, which communities can use free, has particular applicability to drainage problems, because the danger of driving

Fred Block

In the spring of 2003 the **Illinois communities of South Holland, Calumet City, and Lansing** declared Flood Awareness Week and hosted multiple events to raise public and official awareness of local flood problems.

One such event was a floodproofing open house, held on a mid-week evening at a local grade school. It was arranged so that participants first checked in at a registration table, viewed a slide show about local flooding, and were invited to view a new video, "Keeping Your Home Out of Deep Trouble," in a separate room. They then browsed the gymnasium at will, visiting multiple booths and exhibits prepared by public agencies and private firms involved in various aspects of flood loss reduction.

Reponses from the participants were favorable. Most had heard about the open house through the local newsletter, and less than half had experienced flooding in the past.

into flooded intersections is its main message. A "stream cleanup day" could emphasize keeping waterways clear of debris, to minimize drainage problems. A poster contest could feature things people can do to their own homes and yards to make them more resistant to flood damage.

- **Videos** can be produced by the community or local organizations, explaining how, why, and where local flooding occurs, and what can be done about it. The videos can be loaned to groups, shown on local cable TV shows, or used as part of presentations made by community staff. An example of a video prepared by a community college with local retrofitting examples can be viewed at http://www.southholland.org/Resources/flood%20resources.htm.
- **Feature articles** in newspapers or stories in local newsletters can highlight local flooding and send messages about what people can do. These are usually more effective if they are issued at the onset of the rainiest season.

Educate to Build Community Capability

Educating the community's leaders and future residents is an even longer-term approach to preventing flood problems. People who have a thorough understanding about local floodplain resources and the potential for flooding and damage permanently change their attitudes from one of helplessness to one of knowing how to take care of the problems. Over time, this education and changed attitude result in residents who are able and willing to take responsibility for managing the flood hazard. The community will have built the capability to cope with flood risks without relying on State or Federal help. This is never more true than with smaller watersheds and the localized flooding that results in less-than-disastrous damage. More details about building capability among the local government staff can be found in Chapter 3.

Local Staff

Training for community staff who deal with flooding, zoning, permits, engineering, and public works is readily available through FEMA, the States, and professional associations. The national Emergency Management Institute (EMI) in Emmitsburg, Maryland, offers numerous courses on its campus, and some courses are offered throughout the country to address specific issues. Attending or hosting floodplain management workshops and conferences gives local staff members an opportunity to learn more about their fields, network with other communities about their programs, and trade successes and lessons learned.

Elected Officials

Keeping elected officials informed and knowledgeable about ongoing programs and projects is very important. Something as simple as a presentation to City Council every few months can keep decision makers abreast of progress. Inviting elected officials to be present (and visible) at a stream cleanup or an open house on floodproofing gives them an opportunity to deepen their understanding of (and commitment to) flood issues in their districts.

113 Calhoun Street: A Center for Sustainable Living

This building in **Charleston, South Carolina**, is used as a learning center to demonstrate various sustainable building techniques, including flood mitigation. The 125-year-old building, located in the historic downtown district, was already abandoned when it was further damaged by Hurricane Hugo in 1989. The 113 Calhoun Street Foundation, a private, nonprofit organization established by the South Carolina Sea Grant Consortium, Clemson University Extension Service, and the City of Charleston, decided to transform it into a real-life example of sensible building practices and use it as a demonstration project. Funding for floodproofing was obtained from FEMA. People can tour the house, and it also is a focal point for hazard-related education and research.

- All renovations and improvements had to comply with the historic district rules, but a variance to the substantial improvement requirement allowed the house to remain close to street level (elevating to the 100-year flood level would have meant raising it 4 feet, destroying its historic appearance).
- A benefit-cost analysis conducted with FEMA's software showed that raising the structure one foot would protect it from shallow, more frequent localized flooding. It was calculated that the probability of flood damage would be reduced by 60%.
- The original foundation was completely replaced with concrete footings reinforced with steel rods. This prevents it from floating off its foundation in a severe flood. The original brick from the foundation was re-used as a veneer over the concrete block to preserve the historic character.
- The crawlspace is insulated with non-water-absorbing foam insulation.
- All electric, telephone, and computer outlets and furnace, air conditioning, and other ductwork are located above the 100-year flood elevation. There are no splices or connections below that elevation.

Photo courtesy of 113 Calhoun Street Foundation

- Wooden panels, called wainscoting, were installed up to the 100-year flood elevation. These panels are less water-absorbent than wallboard and can be removed after a flood, allowing both the panels and the wall space to dry thoroughly.
- Other protection measures for wind, hurricane, and other hazards were also incorporated.

More information, including a virtual tour, can be found at http://113calhoun.org.

Children and Youths

Environmental and safety education programs can teach children about flooding, the forces of nature, the factors that cause flood problems, and how important it is to protect natural drainageways and the many resources of watersheds. Such programs operate to influence future property owners and elected officials and foster a sense of stewardship for the land and water. Educational programs can be presented through schools, summer camps, parks and recreation departments, conservation groups, and youth organizations.

The Milwaukee Metropolitan Sewerage District and the Milwaukee Public Schools have a partnership to develop an environmental education curriculum focusing on water quality and addressing such issues as floodplain management, flooding, and stormwater runoff.

Sponsoring special workshops for teachers helps them learn more about flooding and gives them ideas and materials for passing that knowledge on to their students.

Professionals

A community whose professionals have an accurate understanding of the flood situation and about rules, requirements, and remedies will be closer to resolving its flood problems.

For floodplain managers and local ordinance administrators, the Association of State Floodplain Managers administers the Certified Floodplain Manager (CFM®) Program to ensure that floodplain management staff are trained and that they keep their skills and knowledge up-to-date through continuing education. Some States operate their own nationally approved certification program for floodplain managers. New Mexico and Oklahoma have state laws requiring that all local floodplain administrators be accredited.

These certification programs connect their applicants and members with numerous training and continuing education opportunities.

Some States license their building inspectors and code officials, and specify the type of training, skills, and abilities that are required to effectively perform those roles.

Other professionals, like real estate agents, insurance agents, and surveyors, are links between flood information and the public. It is in their best interest to have accurate information to pass along to their clients; providing updates, speaking at their regular meetings, keeping them in the loop through their publications, and inviting them to meetings or workshops is a good informational strategy.

Where to Get Help

- Local public information campaigns are underway in many communities, sponsored by the county emergency manager, the local chapter of the American Red Cross, the utility company, school district, parks department, youth groups, and others. Finding a way to combine their projects with information that will raise flood awareness is an inexpensive way to get started.

- The community's webmaster may accept contributions to focus attention on local flooding.
- The local library may welcome displays about flooding, lecture series, and special flood-related collections.
- The Web sites of most Federal agencies with flood mitigation or water resources missions have numerous floodplain and flood protection references that can be ordered, downloaded, or linked to a community's Web site.
- Many State, Federal, and non-profit Web sites have special sections for school children, with downloadable materials, posters, and projects. Some examples are the National Wildlife Federation's Kidzone at http://www.nwf.org/kids/; FEMA for Kids at http://www.fema.gov/kids; or Environmental Kids Club at http://www.epa.gov/kids/.
- The Web sites of cities, such as Fort Collins, Colorado, and Tulsa, Oklahoma, are examples of sites that provide extensive outreach materials to educate their residents about local flooding and floodplains.
- The StormReady program provides proven methods for educating citizens and preparing the community to be ready to handle a storm at http://www.stormready.noaa.gov.
- The CRS publication *CRS Credit for Outreach Projects* has lots of ideas and examples for reaching people with information about flood problems. See http://training.fema.gov/emiweb/CRS/.
- Training courses in floodplain management, flood insurance, the CRS, building protection, and other matters are offered by the Emergency Management Institute. Tuition is usually free to local staff. The schedule and course descriptions can be found at http://www.fema.gov/emi/.
- Information about the CFM® Program of the Association of State Floodplain Managers can be found at http://www.floods.org.
- Project WET (Water Education for Teachers) provides guides and workshops for teachers on many water resources issues. See http://www.projectwet.org/. Educating Young People about Water maintains a catalog of almost

Maryland Residents Watch Their Streams

The Stream Teams program is a way for residents of **Prince George's County** to work together to protect the over 1,500 miles of streams in the county. Stream Teams are groups of friends, work colleagues, families, school classes, scout troops, church organizations, or others who want to work together to protect and restore streams. Each team adopts a stream of its choice and agrees to carry out one or more activities.

There are three levels of Stream Teams involvement, coordinated by the county Department of Environmental Resources.

- A Stream Reporter conducts stream surveys by periodically walking along the adopted stream, observing and reporting problems such as unusual discharges, trash dumps, fish kills, algae blooms, sewage leaks, or sudden sedimentation.
- Stream Activists do stream cleanups, tree plantings, storm drain stenciling, or public education.
- Stream Water Quality Monitors collect and identify certain aquatic insects that are indicators of the water quality in a stream. All Stream Teams attend a free half-day training workshop.

Additional information may be found at the Stream Teams page on the Prince George's County Web site at http://www.co.pg.md.us/government/agencyindex/der/ppd/community/stream_teams.asp.

200 curriculum materials on water resources topics at http://www.uwex.edu/erc/eypaw/.

- The State emergency management agency can be contacted for schedules of technical training for local staff.
- If there is a State-level professional association for floodplain managers, wetlands managers, stormwater managers, or others, it can be a resource for technical training opportunities for local staff. Floodplain management associations can be found at http://www.floods.org/StatePOCs/stchoff.asp.
- Many soil and water conservation districts have staff assigned to help prepare and present educational programs.
- The Turn Around Don't Drown™ campaign, sponsored by the Federal Alliance for Safe Homes (FLASH) and the National Weather Service, has a Web site with safety tips and downloadable brochures, signs, and other outreach materials about the danger of driving during flood conditions at http://www.nws.noaa.gov/os/water/tadd/.

Funding

- Many of the public education and awareness ideas discussed here can be added to or integrated with ongoing initiatives, making the cost of implementing them fairly low and possibly within the operating budgets of many local government agencies.
- Floodplain management messages can be included in other publications and mailings, for example, articles on flood protection in a citywide newsletter, in the water bill, or with the annual tax bill.

Warning and Emergency Services

6

If people know that flood conditions are likely to occur, they can take steps to ensure their own safety and minimize damage to their homes, businesses, and personal property. A flood warning system that does the following things can go a long way toward reducing losses from localized flooding:

- *Identifies flooding threats;*
- *Disseminates information to residents as a warning or advisory;*
- *Signals the need for emergency services; and*
- *Promotes public understanding of flood risks.*

A flood warning and emergency response program focuses on knowing when and where it will flood and doing something about it before the flood causes any damage. In areas subject to localized flooding, the first component of the system—flood threat recognition—would be different from that on larger rivers, but the provisions for spreading the warning, educating people, and developing community response would be essentially the same as for other flood situations.

Communities can obtain CRS credit for their flood warning system. *CRS Credit for Flood Warning Programs* describes the elements of a flood warning system that are eligible for credit under Activity 610 of the CRS:

- Flood threat recognition systems;
- Emergency warning dissemination;
- Other response efforts;
- Critical facilities planning; and
- Being a StormReady community.

Recognizing the Threat

Types of Systems

Before a flood warning program can be developed, the community must have a system that provides advance notice of potential flooding conditions. This is known as flood threat recognition. Nationally, flood threat recognition is managed by the National Weather Service (NWS) and its regional River Forecasting Centers.

When information from radar, remote gauges, or the NWS indicate that conditions are ripe for local flooding, the emergency operations staff can monitor developments and decide if a watch or warning is appropriate.

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The NWS focuses on larger rivers and major threats, such as hurricanes. It cannot track every little stream and ditch. It does monitor conditions and issue flood watches and warnings, but often only for low-lying areas, not crest predictions on individual streams. Therefore, more specific recognition of localized flooding potential is left to local authorities. The NWS can, however, provide technical advice and assistance.

A Local System

There are two major types of local flood warning systems: manual and automated. Deciding which to choose depends on the characteristics of the watershed, the flood loss potential, and the warning time that will be needed for the community to take action.

Manual systems involve a network of residents who collect data by reading rain and river gauges or using other observation techniques. When a predesignated condition occurs (perhaps the gauge measurement reaches a certain level), the gauge watchers contact a community flood coordinator, usually in the emergency management office. The flood coordinator may use paper graphs or a computer model to calculate the impact of the rain and water levels and obtain a simple flood forecast.

Automated systems can be faster, more accurate, and more reliable, but are more expensive than manual systems. As rain gauges fill with water, they tip over, sending a signal to a central monitoring station. Computers record and react to the data provided by the automatic rain and river gauges and calculate a flood prediction.

The amount of damage incurred by localized flooding may not justify the significantly greater expense of an automated system. Further, an automated system may not be

effective for localized flooding because there is often no identifiable flooding source on which to install a stream gauge.

A community and its local NWS office can work together to determine what can be done to develop advance notice of localized flooding. The collective experience of community officials and residents with historic flooding and drainage problems can help inform hydrologists about the conditions under which localized flooding is likely to occur and help them advise the community on the most effective type of flood warning system and what conditions will warrant issuing a warning.

It may be that the NWS general watches or warnings will provide all the advance notice that can be expected. If so, rather than invest a lot of effort in gauges, radios, and computers, the community could use storm spotters, police patrols, and other volunteer weather watchers to advise of potential flooding. It should focus on preparing an appropriate program for disseminating the warnings it does get, teaching people what to do, and developing effective community responses.

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Before this gauge was installed in Matteson, Illinois, two people had died at this underpass. They thought the water was shallow enough that they could drive through, their cars stalled, and they drowned. The gauge is a localized flood threat recognition system that enables motorists to see how deep the water is and avoid risking their cars and lives.

However, it may be possible and very useful to have a system that predicts that low lying areas will flood in the next few hours. Even this general advance notice could help residents move cars or close openings. Such a warning system would be meteorologically focused, with warnings based on precipitation rates, radar displays, the rate of snowmelt known historically to cause flooding, and other factors, rather than on gauges of the precipitation and stream flow.

Issuing the Warning

Even though the community's system for recognizing a threat of localized flooding would be different from the system for larger rivers, the procedures for issuing the flood warning would be much the same as for other hazards. Once NWS flood watches and warnings are received or local information suggests an imminent threat, that information needs to be spread among residents, businesses, critical facilities, and local government personnel.

A community should determine whether, and when, any areas subject to flooding should receive special warnings. For example, some neighborhoods may always be the first to be flooded, even if the flood threat to the rest of the community never rises to the level of a general warning. Or, if the general NWS warning for the community is the best information that is going to be available, perhaps areas subject to localized flooding should receive special instructions beforehand.

FEMA News Photo

Some roads will be blocked because of flooding.

A flood warning should advise people what areas are likely to be flooded, what actions they should take, what actions they should avoid (using closed streets or dangerous intersections, etc.), and what they can expect officials and emergency personnel to do. It should also encourage people to pass the word to others, especially those least likely to hear the warning and those who might need special help.

Responding to the Threat

The Community's Response

After a flood warning is issued, the community sets in motion a previously agreed-upon flood response effort. The actions to be implemented should be part of the emergency response or emergency preparedness plan administered by the emergency manager. Often these plans have a flood annex or separate procedures for flood-specific activities.

The plan should include:

- Instructions for emergency services personnel;
- Identification of roads that should be closed before flooding begins;
- Identification of routes to be kept clear for flood response and access to buildings;
- Procedures for residents to exit the flooded (or blocked) areas; and
- Identification of critical facilities (hospitals, water treatment plants, etc.) that need attention.

Raindrops to Response

Tulsa, Oklahoma, is subject to flooding and flash flooding, often resulting from severe thunderstorms. Tulsa's system for recognizing flood threats and issuing warning information is a cooperative effort among the National Weather Service, the news media, the Tulsa Area Emergency Management Agency (TAEMA), amateur radio operators, and the City of Tulsa.

Tulsa's computerized ALERT (Automated Local Evaluation in Real Time) system includes 39 rain gauges, 19 stream gauges, and seven detention gauges that report changes as they happen. A hydrologic program develops stream and flood forecasts, which are analyzed by the city's Department of Public Works staff in consultation with TAEMA, the Fire Department, and the Police Department, to determine appropriate action.

When warranted, flood watches and flood warnings are issued by the Tulsa NWS office. They are distributed through the National Oceanic and Atmospheric Administration (NOAA) Weather Wire or NOAA Weather Radio, and then via other media.

If the amount of rain expected will cause ponding and other flooding of small streams and depressions, the NWS may issue a "flash flood warning." But sometimes these events are so localized and rapid that a flash flood warning never gets issued. On the smaller flooding sources, local rainfall and river gauges are needed. When street flooding is reported, Public Works staff are sent to the field as spotters, who confirm what is occurring and what action needs to be taken.

In addition to the NWS data, TAEMA also maintains a weather sensor system consisting of two types of radar, which are used to monitor stream water levels and changes in the atmosphere. The system is equipped with its own database that compiles and analyzes data received from the two sensors. A technician analyzes both reports.

When a flood threat is recognized, the next step is to notify the public and staff of other agencies and critical facilities. Residents receive information through the media. Manual and automated telephone systems are used by TAEMA to contact city departments and critical facilities such as area nursing homes, childcare facilities, and hospitals.

TAEMA may decide to activate the emergency warning sirens. Tulsa has 82 warning sirens, each of which can be heard for up to a 1-mile radius. A three-minute alternating "high-low" tone on the siren tells people of impending flooding. Citizens have been instructed that, upon hearing the flood siren, they should avoid low-lying areas or any place where flooding is likely to occur, drive only with caution, and access local media for further information.

The community should conduct practice drills of its response program at least once each year when there is no flood. In addition, an ongoing training program will ensure that local staff are always aware of what to do. The staff should also be trained to test and maintain warning equipment; response equipment, machinery, and supplies; computers, and communications systems.

Site-Specific Responses

The community's plan should specify the personnel responsible for securing critical facilities and providing flood protection for those facilities. Each critical facility should have its own flood response plan that its staff implements. Often, these are prepared and administered by the facility's security office, the counterpart to the community's emergency management office.

The facility flood response plan should cover the following topics:

- Identifying what flood warning message will trigger implementation of the plan;
- Identifying which people need to be called when the warning is issued, their telephone numbers, and where they should report;

St. Tammany Parish, Louisiana

Cars can be damaged in a small amount of water. Moving vehicles to higher elevations before local flooding can significantly reduce the cost of flood damage.

- Operating or closing a gate valve, including how to do it, when to do it, and where it is located;
- Closing door or window shutters on a building or gates in a floodwall, including where they are stored, how they should be installed, and how they should be fastened or locked in place;
- Operating a sump pump system;
- Operating a generator if the power is disrupted, including how to connect or disconnect it, how to start it, how to refuel it, and what circuits should be charged;
- Maintaining the valves, pumps, and other mechanical components;
- Reporting to and communicating with the community's emergency manager; and
- Listing safety measures, such as:
  - Evacuating the building when the flood threatens;
  - Making sure that generators do not injure power company personnel by back-feeding into the power lines; and
  - Ensuring that there is adequate ventilation for generator exhaust.

Informing the Public

Public information before the flood should equip residents with an understanding of:

- The procedure for the warnings, signals used, what radio or television station to listen to, how much time there will be, and the reliability of the warnings;
- What to do during a flood warning to minimize risks to health and safety;
- What to do during a flood warning to reduce property damage;

- How to get help from the Red Cross, local emergency services, and other organizations;
- How to find out which shelters are open; and
- How to obtain supplies, if needed.

It is important to ensure that homeowners are also aware of their options for responding to potential flood threats. The community should provide information about where homeowners can obtain materials for sandbags and other mitigation activities.

Where floodwaters rise quickly, people should be advised that sandbagging may be too little too late. Instead, they should be advised about other measures that can be taken to protect the building. The most effective ones (see Chapter 10) are permanent and need to be prepared in advance, well before a flood warning is given. However, it may be possible on short notice to put protective shields on buildings as illustrated on page 10-5, or to put a few sandbags in crucial places.

People also need to know the location of some nearby, safe parking so they can quickly move their vehicles out of danger. This alone can significantly reduce the cost of damage.

Residents should be advised how to develop a family response plan. Generally, people are more interested in such preparations when they understand that they are useful for fires, storms, and other family emergencies as well.

The Turn Around Don't Drown™ program is a public education program developed by the NWS to help communities educate residents about the dangers of walking or driving in flood waters.

http://weather.gov/os/water/tadd/index.shtml

StormReady Program

Becoming a designated StormReady community is one way to ensure that the community is prepared for localized flooding. The StormReady program is administered by the NWS to help communities become better prepared for storms and other natural disasters. Because it is not limited to the problems of riverine or coastal flooding, the StormReady program guidance and materials are particularly well-suited to localized flooding problems. The Web site, http://www.stormready.noaa.gov, provides guidance for warning dissemination and describes proven methods for educating citizens and preparing the community to handle a storm.

To be officially StormReady, a community must:

- Establish a 24-hour warning point and emergency operations center;
- Have more than one way to receive severe weather warnings and forecasts and to alert the public;
- Create a system that monitors weather conditions locally;
- Promote the importance of public readiness through community seminars; and
- Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.

Being designated as a StormReady community by the NWS is a good measure of a community's emergency warning program for weather hazards. It is also credited by the CRS.

HURRICANE • FLASH FLOOD • HAZARDOUS MATERIALS SPILL
Your
Family Disaster Plan
Federal Emergency Management Agency
EARTHQUAKE • TORNADO • WINTER STORM • FIRE

The Red Cross has a great deal of information on family preparedness.

After the Flood

Recovery

FEMA News Photo

The recovery phase of a flood is a good time for public information programs because people are more aware of the issues and problems caused by flooding.

After a disaster, communities should undertake activities to protect public health and safety and facilitate recovery. Appropriate measures include:

- Ensuring that the basic needs of citizens are met, including shelter, food, and safe drinking water;
- Monitoring for diseases;
- Vaccinating residents for tetanus;
- Patrolling evacuated areas to prevent looting;
- Clearing streets; and
- Cleaning up debris and garbage.

Throughout the recovery phase, everyone wants to get back to normal. The problem is, "normal" means the way they were before the disaster, exposed to repeated damage from future floods. There should be an effort to help prepare people and property for the next disaster. It should include three concurrent tasks:

- Inspecting damaged buildings and public facilities to identify mitigation measures that can be included during permitted repairs;
- Conducting public information activities to advise residents about mitigation measures they can incorporate into their reconstruction work; and

- Updating the community's mitigation plan and applying for assistance made available through the disaster programs.

Inspections

Requiring permits for building repairs and conducting inspections are vital activities to ensure that damaged structures are safe for people to re-enter and repair. Even in shallow flooding, the foundation may have shifted or been undermined; electrical hazards are always a potential danger; and building components that are saturated lose their strength and can collapse, injuring people. There is a special requirement to do an inspection in the Special Flood Hazard Area and other regulated floodplains, regardless of the type of disaster or cause of damage.

The National Flood Insurance Program (NFIP) requires that local officials enforce the substantial damage regulations in their floodplain management ordinances. These rules require that if the cost to repair a building in the floodplain equals or exceeds 50 percent of the building's market value, the building must be retrofitted to comply with the community's floodplain ordinance. In many cases, this means that a substantially damaged building must be elevated to or above the base flood elevation.

There may be pressure from the public and elected officials to waive this regulation in order to help people return to normal as fast as possible, even though that means exposing people and buildings to the type of flooding that caused the disaster in the first place. Further, waiving the requirement is a violation of the community's adopted regulations and its obligations to the NFIP, and can be cause for placement on probation or suspension from the program. However, a community can facilitate post-disaster reconstruction and make the permit requirements more palatable through such techniques as:

- Publicizing the need for permits and explaining how to apply for them;
- Keeping the permit office open later;
- Setting up a permit office in the affected area;
- Having permit officials walk through the flooded area and issue permits to repair minor damage without all the application paperwork; and
- Waiving the permit fee.

The substantial damage requirement can be very difficult for understaffed and overworked offices after a disaster. If these activities are not carried out properly, not only does the community miss a tremendous opportunity to redevelop or clear out a hazardous area, but it also may be violating its obligations under the NFIP. In some areas, mutual aid agreements have been established so building inspectors from a community not affected by the disaster can work in the communities that were hit the hardest.

The Federal Emergency Management Agency (FEMA) has developed software to help local officials make substantial damage determinations. The software comes with a manual, *Guide on Estimating Substantial Damage Using the NFIP Residential Substantial Damage*

Estimator, FEMA 311. Copies can be obtained from the FEMA Regional Office. Training sessions and technical assistance may be available after a disaster declaration.

Public Information Activities

People need to recognize that returning to normal may mean returning to a building that will be damaged by another flood. The community should inform its residents and businesses about the regulatory requirements and the need to clean and rebuild carefully. This can be done through news releases and handouts.

Repairing Your Flooded Home

This classic handbook from the American Red Cross and FEMA guides flooded property owners through the steps they need to take to re-enter and re-occupy their homes after the flood waters retreat. Lots of illustrations, lists, and references to further sources of information combine to describe how to clean up, repair, and stay safe. Each chapter, listed below, describes one step.

Step 1. Take Care of Yourself First
Step 2. Give Your Home First Aid
Step 3. Get Organized
Step 4. Dry Out Your Home
Step 5. Restore the Utilities
Step 6. Clean Up
Step 7. Check on Financial Assistance
Step 8. Rebuild and Floodproof
Step 9. Prepare for the Next Flood

Hard copies of the book are available from local Red Cross chapters or by writing to FEMA, P.O. Box 2012, Jessup, MD 20794-2012.

http://www.redcross.org/services/disaster/0,1082,0_570_,00.html

Sometimes, FEMA or the Red Cross will make copies of *Repairing Your Flooded Home* available in bulk quantities, or the community can copy and distribute appropriate pages.

The messages that should be disseminated should cover:

- Safety precautions when returning to a damaged building;
- Which activities require a permit;
- How to apply for a permit;
- Which activities do not require a permit (e.g., cleanup and emergency repairs to prevent further damage);
- The substantial damage rule;
- The benefits of Increased Cost of Compliance flood insurance coverage (see Chapter 11);
- How to determine the need for licensed contractors, if licensing is required by the community;
- How to implement steps 2, 3, and 4 in *Repairing Your Flooded Home*, such as taking pictures for insurance and disaster assistance claims before throwing things away, and health and safety precautions; and
- How to include retrofitting measures as part of repairing homes or businesses.

Mitigation Activities

During the recovery phase of a flood, everyone is more sensitive to flooding and interested in doing something about it. It is a good time to build awareness, educate residents, and get the public involved in mitigation and other community activities.

The community should evaluate how the warning and response systems worked during the flood. Information should be collected about where flooding occurred and which properties were affected. Documenting high water marks can help a community make decisions about potential regulatory changes. It may be useful to use this information to redraw flood hazard maps, as Conway, South Carolina did (see Chapter 4).

Community staff should go with the disaster assistance staff as they inspect public facilities and identify opportunities for mitigation during reconstruction of the facilities. Certain public and private nonprofit facilities are eligible for additional funding for approved mitigation measures.

The staff should review and update the community's mitigation plan to reflect what is learned about the flooding hazard, the lessons learned from the community's flood response, information collected during the building inspections, and available mitigation funding.

During post-flood rebuilding, it also can be possible to incorporate sustainability principles into individual buildings or into neighborhoods. In **Grand Forks, North Dakota,** for example, people who had to replace their furnaces or hot water heaters because their basements got wet during the 1997 flood were offered rebates by the community and the local utility to encourage them to replace the old models with more energy-efficient systems.

More information on redevelopment is given in Chapter 9, and the U.S. Department of Energy has a large compilation of suggestions for similar measures at its "Smart Communities Network" at http://www.sustainable.doe.gov/disaster/disintro.shtml.

After a flood in 1995, **Jefferson Parish, Louisiana,** examined the causes of flooding problems in the Dumonde Subdivision. The area had been flooded four times in the previous 10 years. The investigation found two homes and a wooden fence that obstructed drainage from the subdivision. The Parish applied for and received a Hazard Mitigation Grant from FEMA. It acquired the properties, cleared the buildings and the fence, and restored the drainage system

Where to Get Help

- The county office of emergency services or emergency management is a good source of information, and can describe how other communities are addressing flood warning systems, response, and public education.
- The National Weather Service is an essential contact on flood threat recognition and warning. Each Weather Service Office has a hydrologist who can help set up a local flood warning program. They can be found at http://www.nws.noaa.gov/organization.html.
- The National Weather Service StormReady Program can be accessed at http://www.stormready.noaa.gov.
- The local chapter of the American Red Cross can provide recovery assistance and should be included in a community's response and recovery planning. It can also provide valuable information on family preparedness. http://www.redcross.org.
- The State Office of Emergency Management can provide guidance on warning systems, emergency response planning, and mitigation resources.

- FEMA has many resources for helping to prepare residents for flooding at http://www.fema.gov/hazards/floods/floodf.shtm.
- *CRS Credit for Flood Warning Programs* provides guidance on flood threat recognition, warning dissemination, and flood response planning.
- Technical assistance and financial help for post-flood mitigation projects are available from a variety of sources. The first place to contact is the FEMA Disaster Field Office, if a Presidential disaster declaration has been made. The next place is the State emergency management agency.
- Examples of flood warning and public safety publicity can be found in *CRS Credit for Outreach Projects*.

Additional resources are listed in Appendixes A and B.

Part III

Neighborhood-Level Tools and Techniques

Part I of this guide notes that actions to solve localized flooding problems can be taken at three different levels: at the community level, at the neighborhood level, and by individual structure. Part II discusses the community-level approaches.

Part III focuses on the specific neighborhood or block where the flooding takes place. Chapter 7 reviews the area analysis, a process that determines whether flood protection approaches should be pursued at the area (or neighborhood) level. There are two types of area-wide approaches: making improvements to the drainage system, or redeveloping one or more parcels. Chapter 8 covers drainage system techniques that are appropriate at the neighborhood scale, and Chapter 9 describes redevelopment options.

Part III:

Chapter 7. Area Analysis

Chapter 8. Drainage Improvements

Chapter 9. Redevelopment

7

Area Analysis

In order to determine whether one of the neighborhood-level approaches (discussed in the remaining two chapters of Part III) would successfully resolve localized flood problems, an area analysis needs to be conducted. The area analysis is a scaled-down plan that focuses on a relatively small portion of the community. If it concludes that there are no feasible or appropriate drainage or redevelopment projects that would resolve the localized flooding problem, the community would pursue protection measures on an individual building basis (covered in Part IV).

The "Area"

Delineating Areas

The first step in an area analysis is to determine the boundaries of the area, watershed, or neighborhood to be reviewed. There is no standard or optimal size area or typical number of buildings involved. An area for analysis can have 1 building or 100 or 1,000, as long as it is an area of contiguous properties subject to the same source of flooding. Areas subject to local drainage problems and flooding outside the mapped Special Flood Hazard Area (SFHA) usually will be relatively small.

The ideal approach is to start with the most frequently flooded sites and delineate the drainage basin or subwatershed that drains to them. This can be done if adequate topographic maps are available. Sometimes, such as in flat areas or neighborhoods subject to sewer backup, this can be difficult.

An important part of an area analysis is to work with the property owners. Therefore, the area should be delineated, where possible, to include existing neighborhoods or neighborhood organizations, even if this means extending the boundaries of the area to be analyzed beyond the drainage basin boundaries.

Prioritizing Areas

The community can conduct an area analysis for areas that have requested it or that have been flooded recently. Or, it can delineate all localized flood problem areas and set priorities to analyze each in turn. It is a good idea to prioritize all action items, expenditures, and projects, and document why certain items are given precedence. Documenting the prioritization process can help keep planners impartial and justify funding for projects. The following factors can be considered when prioritizing areas:

- Start with areas with properties that are on the Federal Emergency Management Agency (FEMA) severe repetitive loss or repetitive loss list and are priorities for FEMA mitigation funding programs. Contact your local floodplain coordinator or Regional FEMA Office for assistance.
- Start with smaller areas that will be easier to analyze. It is a good idea to begin a program by tackling the smaller, more manageable problems and then move on to the larger problems as procedures and expertise are improved.
- Start with the areas where the residents are actively requesting assistance or that have been recently flooded. These areas are most likely to have motivated, interested property owners who will be willing to cooperate with the community's effort.
- Start with the areas that have the greatest flooding threat to health and safety, such as areas subject to flash floods or fast-moving flood waters.

Conducting the Analysis

The objective of the analysis is to determine if there is a feasible and appropriate way to reduce flood damage at the area or neighborhood level. The analysis can be informal or highly organized. In either case, it is important to involve the owners of the affected properties. A written report is also recommended, showing the process that was followed and the rationale for the conclusions.

The following five steps are suggested:

1. Advise the neighborhood about the upcoming analysis.
2. Determine the cause and extent of the problem.
3. Review alternative area-level approaches.
4. Contact other parties about their activities and possible coordination of efforts.
5. Document the findings.

Step 1. Advise the neighborhood.

Residents and owners of the properties in the area should be told that the community plans to initiate the analysis. This notification can be done through the mail or at a public meeting. The notice should include the following:

- Review the reasons for the analysis and the process that will be followed.
- Request information on the causes and impacts of past flooding. Use a form to facilitate review and summary. An example of a request for this information is shown on the next page.
- Inform residents that all information is voluntary.
- Advise that field crews or surveyors will be in the area and include the dates, if known. Explain that community staff have identification cards.
- Provide the name and telephone number of someone who can answer questions.
- Provide the date, time, and place of a meeting that will review the results of the analysis.

Step 2. Determine the problem.

The community's engineer should review available data, such as:

- The community's Flood Insurance Rate Map (FIRM) and Flood Insurance Study;
- Other flood studies and reports;
- Stormwater management plans;
- A topographic map or other source with more detailed contour data than the map used to prepare the FIRM (see the Gurnee and Conway examples in Chapter 4);
- Questionnaires and information provided by the residents;
- Flood insurance claims data that provide the location and dates of flood events and the extent of damage (see Where to Get Help); and
- Field investigations to locate or confirm channel obstructions or other reported causes of flooding.

A hydrologic and hydraulic study is not necessarily warranted at this step, nor are detailed flood elevations needed. Step 2 can be performed using engineering judgment and staff experience. The product of Step 2

FEMA has developed a useful software application to collect information on flood problems and building conditions. The National Flood Mitigation Data Collection Tool provides a step-by-step process to gather information on each building in the area to be analyzed. If the area analysis concludes that site-specific approaches should be pursued, the data and the software can be very helpful in determining which measures would be most appropriate.

Village of Gurnee/Lake County, Illinois Stormwater Management Commission
Flood Protection Questionnaire

Property address: _____

1. Has your home or property ever been flooded or had a water problem? ( ) Yes ( ) No
   If "yes," please complete this entire questionnaire.
   If "no," please complete questions 6 – 9.

2. In what years did it flood? _____

3. Where did you get water and how deep did it get?
   ( ) In basement: _____ deep.
   ( ) In crawl space: _____ deep.
   ( ) Over first floor: _____ deep.
   ( ) Water kept out of house by sandbagging, sewer valve or other protective measure.
   ( ) In yard only.

4. What do you feel was the cause of your flooding? Check all that affect your building.
   ( ) Storm sewer backup ( ) Sanitary sewer backup
   ( ) Sump pump failure/power failure ( ) Saturated ground/leaks in basement walls
   ( ) Standing water next to house
   ( ) Overbank flooding from _____ River/Lake
   ( ) Other: _____

5. Have you installed any flood protection measures on your property?
   ( ) Sump pump ( ) Backup power system/generator
   ( ) Overhead sewers or sewer backup valve ( ) Sewer plug or standpipe
   ( ) Waterproofed walls ( ) Moved things out of the basement
   ( ) Regraded yard to keep water away from building
   ( ) Other: _____

6. When did you move into the building? _____

7. What type of foundation does your building have?
   ( ) Slab ( ) Crawlspace ( ) Basement _____

8. Do you have flood insurance or a sewer/basement flood rider to your homeowner's insurance?
   ( ) Yes ( ) No

9. Do you want information on protecting your house from flooding or sewer backup?
   ( ) Yes ( ) No If yes, please include your full mailing address.

Please include any comments you may have about flooding in your area.

This questionnaire was sent to residents of a flood-prone area in Gurnee, Illinois.
[The reverse side had the Village Hall address and a stamp so the form could be folded and mailed after it was filled out.]

would be a narrative and/or map. Examples of findings from a community's investigation are listed in the table below. It is important to remember that if a drainage modification project looks feasible as an alternative, a hydrologic and hydraulic analysis will be needed to make sure the improvement is properly sized. Too often a community goes forward with a poorly conceived solution that is destined to fail, is under-sized for the job, or worsens flooding elsewhere.

Examples of Flood Problems and Possible Approaches to Resolve Them

Problem Statement	Approaches to Investigate
On four occasions in the last 5 years, local storms overloaded the ditch along County Road 14 and flooded nearby houses. The ditch has filled in with sediment over time and can no longer carry flows from a severe storm.	• Dredge the ditch • Enlarge the ditch • Initiate a drainage maintenance program • Install an underground sewer
The storm sewer system was designed and installed in 1950. At that time, it could handle the 10-year storm from the upstream drainage basin. Since then, the basin has been urbanized and the amount of runoff has substantially increased. The storm sewers have deteriorated over time and now surcharge once every 2 years on the average.	• Install an upstream storage basin • Install larger storm sewers
Intense storms in June 2000 and July 2001 resulted in overland flow over construction sites on Vine and Race Streets. Lumber, trash, and other loose items were washed into the ditch. The debris caught at the culvert under Broadway and plugged the pipe, resulting in a 3-foot backwater which flooded eight houses.	• Enlarge the culvert • Install a trash rack • Initiate a drainage maintenance program • Enforce a construction-site housekeeping program
The houses at 103, 105, and 107 Elm Street are bi-levels with garages below grade. Approximately once each year, stormwater runoff flows onto Elm Street to a level higher than the sidewalk. The water flows over the sidewalk and down the driveways. Only these three properties have been affected.	• Improve the storm sewers • Raise the sidewalk • Install an upstream storage basin • Acquire the three homes
Flood insurance records show damage to 12 houses and one business on July 1, 1990, August 3, 1995, July 26, 1999, and July 17, 2002. A review of the area shows that there are 15 similarly situated homes and businesses that either were not insured or did not have enough damage to warrant a claim, but are likely to have been flooded on these dates. The area is very flat and poorly drained. Construction of homes and streets in a grid pattern has cut the drainageways that existed before development. This is an area that should not have been developed without construction of new drainage ditches and pumps.	• Improve drainage • Acquire the lowest properties and redevelop the site as a storage basin

Step 3. Review alternative approaches.

The objective of the area analysis is to determine if an area- or neighborhood-level approach is feasible and appropriate. Chapters 8 and 9 discuss specific techniques under these approaches. Here are some examples of neighborhood-level approaches.

- Drainage modifications, such as removing obstructions or enlarging culverts, ditches or storm sewers, to carry the floodwaters away from the area;
- Storage basins to hold the water upstream from the area and/or release it over time;
- Levees, floodwalls, berms, and other structures to divert floodwaters away from flooded properties;
- Better maintenance of the drainage system to remove obstructions to low flows; and
- Acquisition of some or all of the flood-prone properties and conversion to open areas that will not be damaged when flooded or to other appropriate uses.

Some approaches will be obvious while others will take some time to investigate. If residents have voiced a strong opinion about one or two approaches, these should be studied, even if the professional engineer thinks they are not feasible. The success of this program depends on local support; resident interests should be pursued and the advantages and disadvantages of each approach should be clearly explained.

Examples of approaches that could be explored for different problem scenarios are shown in the table on the preceeding page. Although these solutions may appear simple, the engineer will need to review their pros and cons and determine if they effectively reduce the flood problem and are also affordable.

The area analysis process can be abbreviated if the problem is small or the solutions are obvious. In the first example in the table on page 7-5, it may be that neighbors and the analyst agree that cleaning out the ditch would alleviate the flooding problem. Such a project could be conducted by a public works crew in a day. All that would be needed is a memorandum for the record that explains the problem and recommended solution.

The more formal step-by-step process is recommended for:

- Larger problems;
- Problems that have resulted in resident complaints over the years;
- Problems with no obvious solution; and
- Problems that will be expensive or disruptive to the neighborhood.

For example, installing larger storm sewers appears to be the answer to overloaded storm sewers. However, replacing existing sewers can be very expensive and the impact of increased flows onto downstream properties would need to be considered. Such an approach may be readily ruled out as infeasible by an experienced engineer. If so, the analyst needs to provide a rough cost estimate, rather than summarily state that it is too expensive.

Step 4. Contact other parties.

Other agencies or organizations may have plans that could affect the cause or impacts of the flooding. For example, if the roadside ditch is along a State or county highway, are there plans to work on the road or improve the ditch? Key agencies and organizations that should be contacted include the following:

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Sometimes a minor ditch-clearing project can stop flooding and drainage problems.

- Drainage, levee, sewer, or sanitary district responsible for flood, drainage, or sewer problems;
- Local or State street or highway department that may improve a ditch, bridge, or culvert or construct a project that will affect drainage;
- Parks department or school district that may be interested in expanding open space lands or athletic fields;
- An adjacent landowner or a developer or economic development agency that may be interested in acquiring, clearing, and redeveloping some properties;
- State emergency management or State National Flood Insurance Program coordinating office, council of government, or regional planning agency that would know of ongoing mitigation efforts, funding sources, and their priorities; and
- Environmental or open space organizations, such as the Nature Conservancy or the Trust for Public Land, that might be interested in converting problem areas into open space.

The analyst should discuss the findings from Step 3 with the agency or organization to determine if there are opportunities for cooperation, coordination, cost sharing, or modifying the approach to gain support from the agency or organization.

Step 5. Document the findings.

The analyst should prepare a short report that includes the following items:

- A summary of the process that was followed;
- A summary of residents' comments and/or a tally of the questionnaires;
- The problem statement with a map of the area affected and/or the drainage basin, if possible;
- The alternatives reviewed and their advantages and disadvantages;
- Relevant activities by other agencies and organizations; and
- Conclusions and recommendations.

The document should be reviewed, either by another engineer or by the community's upper management. Upper management or an elected official (e.g., the council member for the area being analyzed) can verify that the recommendations are politically acceptable.

Follow-Up Activities

A draft report will be the likely product at the end of Step 5. Before it is officially adopted as the way to reduce flood damage for the area, three follow-up activities should be pursued.

Neighborhood Review

Neighborhood support is vital, especially if the proposed project depends on access onto private property, obtaining easements, or voluntary sales of property. The analysis findings should be reviewed with the residents and property owners of the affected area.

If it is not too long, the document could be sent to everyone. An alternative is to send a notice to everyone with a Web link to where the document can be read.

There should also be a meeting with the neighbors. The author of the analysis can review the problem, the alternatives, and the conclusions and recommendations. The community can gauge support for the recommendations at the meeting. Unanimous support may not be necessary, but if there is strong opposition, the recommendations may need revision or extra time may be needed with the concerned parties.

There may be many cases in which the area analysis concludes that there is no appropriate or feasible drainage, flood control, or redevelopment project. In these situations, community staff should begin looking at site-specific projects, such as retrofitting.

The meeting to review the findings of the area analysis can be used to introduce the concept of site-specific approaches and to schedule appointments with the property owners.

Detailed Plans

If the recommended project proves appropriate (i.e., it will reduce flood losses and has resident support), it should be verified that it is also feasible (i.e., it is cost-effective and can be funded). The analyst should have estimated the cost and reviewed cost-

effectiveness during Step 3. Some level of hydraulic and hydrologic analysis will probably be needed.

For small projects, such as cleaning out a ditch, no further details may be needed. For larger projects, a formal cost estimate may need to be prepared. If FEMA funds will be sought, a formal benefit-cost analysis (BCA) should be conducted, preferably using FEMA software, because it will be required when application is made. The community may opt to contract out this work for very large projects.

Funding

The final activity is to schedule and fund the recommended project. Small projects, such as ditch cleaning, may just be a work order for the public works department. Larger projects may have to be funded or budgeted individually.

There are usually four sources of funds for a flood mitigation project:

- Local funds;
- State funds;
- Federal funds; or
- The benefiting properties.

Typically, larger projects use a combination of sources. For example, most State and Federal programs will only fund a percentage of a project's cost and require a local cost-share to make up the difference.

Local Funds

Most communities have operating budgets and capital budgets. Operating budgets fund routine activities and capital budgets fund one-time-only construction projects. Smaller flood mitigation projects can often be funded from an operating budget account, while larger ones are considered capital improvement projects.

Typically, operating budgets are funded by taxes, such as property or sales taxes. There are usually limits to how much can be raised, so flood projects compete with other community concerns for the limited funds available.

Capital budgets are often funded by bond issues. Some bond issues require a referendum that sets the purpose and the amount of funds to be made available. Again, there may be a limited amount of money available.

The CRS provides credit under Activity 540 (Drainage System Maintenance), if the community has an ongoing program, such as a capital improvements plan, "to eliminate or correct problem sites or to construct 'low maintenance' channels or other facilities." There is no credit for this item if the community does not spend money on a regular basis on such improvement projects (a one-time-only project would not be credited). More information can be found in *CRS Credit for Drainage System Maintenance*.

Increasingly, communities are turning to sources other than their limited general-purpose taxes. Sometimes special revenue sources can be used. For example, if a roadside drainage ditch is causing a localized flooding problem, the community

may be able to use its share of the State gasoline tax to make improvements that also reduce street flooding. Projects to relieve or prevent sewer backup are often funded by sewer utility revenues.

The most promising new source of local funding is the **stormwater utility**. Stormwater utilities charge each property according to how much it uses the stormwater system (i.e., how much stormwater runoff it generates). As with a water or sewer utility, everyone pays according to how much they use the system. Unlike some taxes, no properties are exempt. Utility bills are sent to all properties, or the stormwater fee is included in the water or sewer bill.

Typically, each single-family home pays a base rate, usually $2 to $5 per month. Other properties pay according to their "equivalent residential unit" amount of impervious surface. A five-acre shopping center with a parking lot would pay more than a five-acre lot with one building and a lawn. Often credits are provided for good stormwater management practices, so a shopping center with a storage basin would pay a lower utility fee.

Stormwater utilities have proven to be a dependable source of funds for both operating and capital expenses. A set amount of money is raised each year for flood mitigation that is not subject to diversion to other uses. Communities with stormwater utilities have greatly improved their stormwater and flood protection programs.

State Funds

Some States have special appropriations to fund local flood protection, acquisition, and retrofitting projects. Some examples include:

- Washington's Flood Control Assistance Account Program receives $4 million from the State legislature every two years.
- Minnesota's Flood Damage Reduction Grant Program provides 50% of the local cost of flood mitigation projects.
- Virginia collects surcharges on insurance policies and places the funds in a State mitigation fund.
- Florida has several dedicated State funds that can be used for flood mitigation, including the Emergency Management Preparedness Assistance Trust Fund, the Residential Construction Mitigation Program, and the Communities Trust Program.

More information on State programs can be obtained from the State National Flood Insurance Program (NFIP) Coordinator. A directory of State NFIP coordinators can be found at http://www.floods.org/StatePOCs/map.asp.

Federal Funds

Several Federal agencies can provide funding support for certain types of flood protection projects. This section identifies the programs and where more information can be obtained.

FEMA has several grant programs for acquisition, retrofitting, and small drainage improvement projects. The Hazard Mitigation Grant Program, Flood Mitigation Assistance, and Pre-Disaster Mitigation program are explained on pages 9-9 and 9-10. For more information, contact the FEMA Regional Office (see http://www.fema.gov).

The **U.S. Army Corps of Engineers** can help design and fund flood control projects. For the local Corps of Engineers district, see http://www.usace.army.mil.

The **Department of Housing and Urban Development** administers the Community Development Block Grant program. Larger cities and counties receive entitlement grants; smaller communities apply to their county or State community development agency. Funds may be limited to projects that benefit low- and moderate-income families or economic development. Block Grant funds can also be used to help cover the non-Federal match required by other Federal programs. For more information, see http://www.hud.gov/offices/cpd/communitydevelopment/programs/index.cfm.

Benefiting Properties

A fourth source of funding for a project to reduce flood damage is the owner of the property who benefits from the project. In many communities, the **property owner** has paid the 25% non-FEMA cost share for an acquisition or retrofitting project. Sources of assistance to help these people are summarized on pages 10-20 through 10-21.

Many communities have the authority to create **special service districts** or levy **special assessments**. In these situations, owners of the benefiting area pay an additional property tax. The additional tax revenue is used to retire the bonds that funded the project. Each State has its own procedures for using these tools.

Impact fees are contributions from developers. They are designed to offset the cost a new development will add to the community's expenses. For example, if a new subdivision increases the amount of runoff that drains into the community's storm sewer system, the developer might be charged an amount sufficient to pay for increasing the capacity of that system.

In Fairfax County, Virginia, for example, developers are required to contribute to the cost of handling the increased stormwater runoff produced by their developments. The fees are put into a fund for drainage projects. The fund can pay for a retrofitting project where it is shown to be an economical way to handle a drainage problem. The project illustrated on page 10-7 was funded under this program.

Where to Get Help

- There are no special programs to help fund an area analysis, although such work is primarily staff time, which may not need outside funding support.
- Federal Emergency Management Agency Regional Offices.
- FEMA has a benefit-cost (BCA) helpline at 1-866-222-3580 to answer questions regarding the benefit-cost procedures.

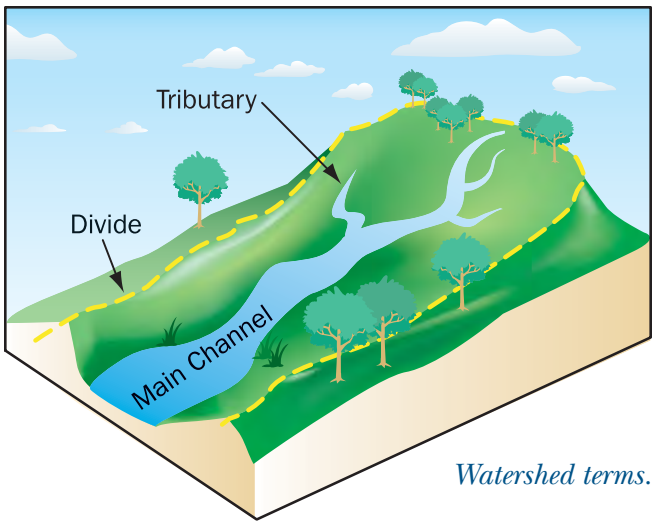
Additional resources are listed in Appendixes A and B.

8

Drainage Improvements

Every community has a drainage system, either natural or human-made or, more likely, a combination of both. The drainage system carries surface water from where it falls (or where the snow melts) through channels to a receiving body of water.

This chapter focuses on improvements to local drainage systems. In most cases, these improvements will be applicable to small streams or areas with stormwater drainage problems. The types of drainage projects described here are smaller than flood control projects, and would not be expected to alter a 100-year flow or result in a change in a flood hazard area boundary. However, if communities implement the measures outlined in this chapter, they will see a reduction in overall flooding problems.



Watershed terms.

The Drainage System

Terminology

The setting for the drainage system is the **watershed**. A watershed is an area that drains into a lake, stream, or other body of water. Other names for a watershed are "basin" or "catchment area." Watersheds vary in size, and larger ones can be divided into sub-watersheds.

The boundary of a watershed is a ridge or a **divide**. Water from rain and snowmelt is collected by the smaller channels, or **tributaries**, which can be natural streams, ditches, or **swales**. Swales are shallow flow areas that may not look like a defined channel. These tributaries collect the surface water and send it to larger channels and eventually to the lowest body of water in the watershed (main channel).

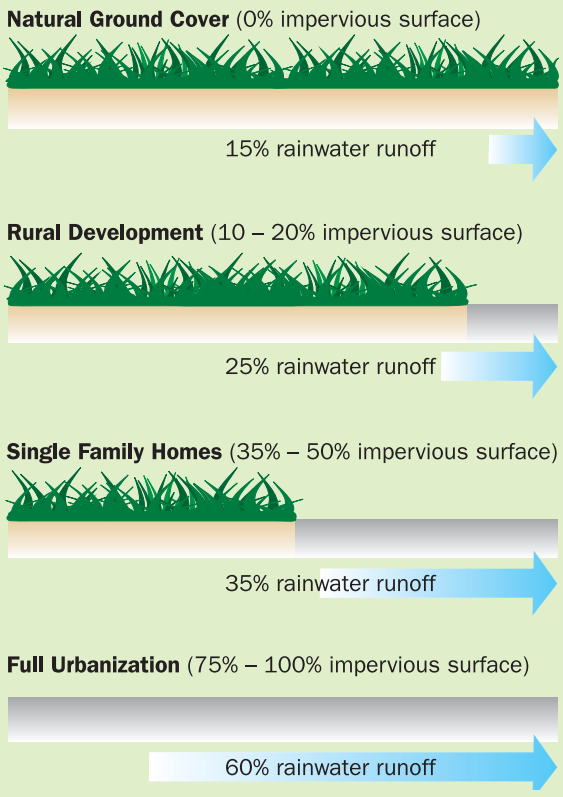
When there is too much surface water, it flows out of the channel and floods the adjacent areas. This scenario can happen along the main channel, where the floodplain may be mapped on the community's Flood Insurance Rate Map (FIRM) as an A Zone. Or, it can happen along the smaller upland tributaries, ditches, and swales, which may not be mapped on the FIRM, but are shown as a B, C, or X Zone.

What happens in a watershed affects events and conditions downstream. In relatively flat areas, shallow, slow-moving flood water may cover large areas of land for days or even weeks. In hilly areas after a heavy rain, a flood may come and go in minutes.

Development and Drainage

If the watershed and its floodplains are undeveloped, water is temporarily stored while the channel is overflowing. This allows excess water to filter into the ground during and after the rain or snowmelt, reducing the amount of water moving downstream.

Stormwater runoff increases as areas are urbanized


Natural Ground Cover (0% impervious surface)
15% rainwater runoff
Rural Development (10 – 20% impervious surface)
25% rainwater runoff
Single Family Homes (35% – 50% impervious surface)
35% rainwater runoff
Full Urbanization (75% – 100% impervious surface)
60% rainwater runoff

Note: These represent findings from land use conversions in the Chicago area. Actual values are site-specific and depend on the initial land use condition, soil type, degree of ground saturation, and the storm's duration.

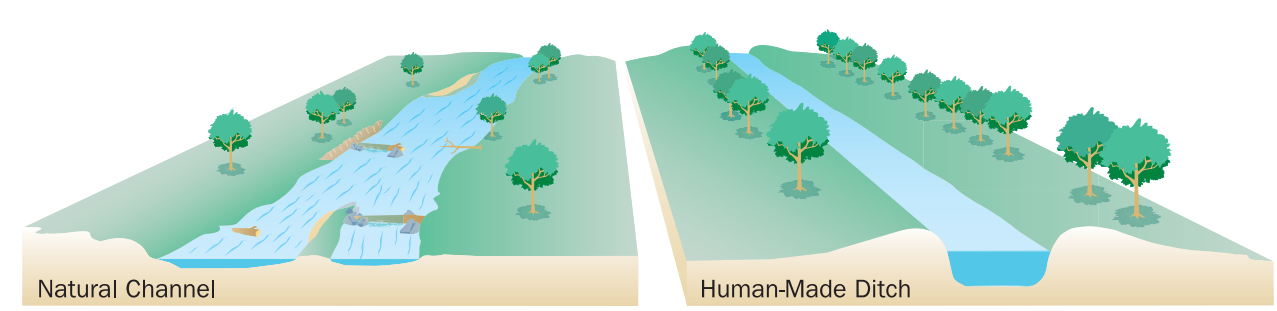
The buildings, streets, and parking lots that accompany human development replace the natural ground cover, which allowed infiltration into the soil, with impervious surfaces, which do not allow water to be absorbed. Storm sewers and ditches collect surface flows and discharge them away from developed sites and into downstream systems.

When rain falls in a natural setting, as much as 85 percent of it will infiltrate into the ground, evaporate, or be absorbed by plants. Human development in the watershed and the floodplains changes the natural conditions of the ground surface. In an urbanized area, as much as 60 percent of it will run off, as illustrated on this page.

The result of urbanization is that there is more runoff in the watershed, which can increase flooding downstream. For example, the amount of runoff from a 5-year rainfall on a developed parcel in the Houston area can be more than the runoff from a 50-year rainfall on the same parcel had it had been left undeveloped; this overloads the drainage system.

Urbanization also changes the timing of flows along the tributaries. After a subwatershed develops, the peak runoff will leave sooner than it used to, possibly arriving at the main channel at the same time as the peak arrives from another tributary, causing increased flooding downstream.

General Channel Types



A community's drainage system is usually a combination of natural and human-made channels and storage basins.

A **natural channel** typically has a wider area in which to flow. Trees and small log or debris jams can be accommodated by minor diversions of flow without causing any problems. In fact, vegetation and minor obstructions that cause riffles and pools are desired in many natural streams because they improve habitat and water quality.

A **human-made drainage ditch** or canal is typically designed to use less surface area to carry more water. These channels need more attention because there is no room to carry overflows caused by blockages. They are not intended to have trees or other vegetation growing in them. In human-made ditches, too much vegetation is considered "debris."

CRS Credit for Drainage System Maintenance, page 9

Conveyance

The drainage system can perform two functions: it carries water away and, during times of high water, it may store water until it can be carried away. The drainage system therefore contains conveyance systems and may contain storage facilities.

Traditionally, human alterations to drainage systems focused on conveyance. People wanted to move water away from a site as quickly as possible. Ditches and storm sewers were built to collect the surface water more quickly and send it to the larger streams. Natural channels were altered to be larger and/or straighter so they could carry more water more efficiently.

Urban or human-made channels are different from the natural channels. As illustrated here, human-made channels may carry more water, but may need more maintenance to provide proper conveyance. To function properly, it is necessary that they be kept clean and clear.

The urban drainage system also includes storm sewers (i.e., pipes) that carry smaller flows underground. When storm sewers work, the streets and yards are drained quickly. Storm sewers won't work for storms

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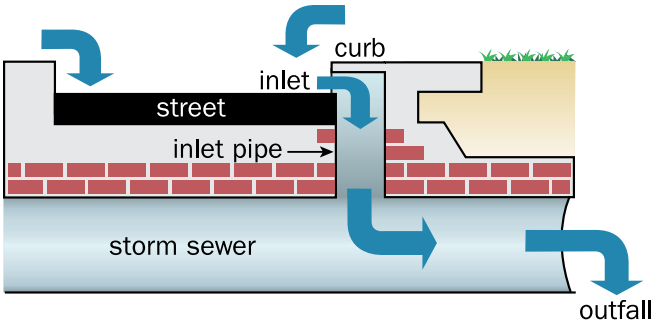
Human-made ditches can carry more water, but they may require more maintenance.



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Storm sewer terminology.

greater than their design specification, or when they are blocked. Typically, neither the storm sewer nor the inlets are designed to handle larger storms, such as the 100-year event; overflow paths should be provided that will protect surrounding buildings from damage.

Blockages can be caused by debris at the inlet, an outlet or outfall that is under water, a broken pipe, or debris or sediment in the pipe (see diagram for terminology).

After a watershed is developed, the natural channels in urban drainage systems have to carry more water for longer periods. As a result, the water scours the channel bottom and banks and increases bank erosion.

In the last 30–40 years, communities have been using storage basins as an alternative approach to addressing the problems created by urban drainage channels.

Storage

Under natural conditions, the floodplain provides storage for the drainage system. When a stream floods, the water is often stored in the floodplain area outside the waterway's banks. The excess water drains back into the river as the water level goes down.

Today's drainage systems typically include human-made storage basins, especially in the newer areas. Storage basins can be dry or wet. Dry basins are intended to drain completely and not to hold any water between storm events. The land may be used for other purposes, such as a park or playing field.

Wet bottom basins have permanent pools of water that function like natural ponds. Excess runoff is stored above the permanent water level in the basin and is discharged at a reduced rate through an outlet. Some communities prefer wet basins because they provide a water amenity, but others may be concerned about the safety hazard of having children playing near a body of water.

Communities have built larger basins to reduce flooding in developed areas and they require new developments to build basins to store their excess runoff on site. As noted in Chapter 4, most communities now require that new developments ensure that the peak flows leaving their sites are no greater than they were before the development.

A third approach is to incorporate natural storage areas into the design of the drainage system. Preserving wetlands and natural depressions has been found to be very effective for storing (and filtering) flood waters. See the example of Butterfield Creek on page 4-15.

Water Quality

Human activity within a watershed affects how and where stormwater runoff flows and also affects the quality of the water. Most stormwater runoff affected by human activity eventually ends up in a stream, river, lake, or other water body. There are

many programs to monitor, regulate, and in general protect streams, rivers, and lakes from being polluted by contaminated runoff, discharges of pollutants, and other sources.

One program that affects most communities was established under the Federal Clean Water Act to ensure that only water of a certain quality is discharged into the waters of the United States. The National Pollutant Discharge Elimination System (NPDES) regulates the type and amount of pollutants and sediment that a community can release from its drainage system into a water body (see below).

Water quality is not the subject of this guide, but it is important to keep its principles and goals in mind when considering the drainage system, because many of the techniques for preventing and relieving localized flood problems are the same as those for preventing water pollution.

Local Stormwater—Quality and Quantity Intertwined

Section 402 of the Clean Water Act directed the U.S. Environmental Protection Agency (EPA) to develop and implement a program to prevent harmful pollutants from being released into the nation's surface water from sources such as wastewater treatment plants, agricultural operations, and stormwater drainage. Under the program (the National Pollutant Discharge Elimination System (NPDES), which is administered by most states on behalf of EPA), most communities that operate a storm drainage system must obtain a permit to discharge their stormwater drainage into a local water body. To get the permit, the community must have a local stormwater management program that includes these components, most of which are also fundamental to sound management of flood problems:

1. Public education and outreach on stormwater impacts.
2. Public involvement and participation.
3. Identification and elimination of illicit discharges to storm sewers.
4. Control of construction site runoff.
5. Control of stormwater runoff from development.
6. Reduction of pollutant runoff from local government operations.

The NPDES permit specifies what can be discharged, how the level and type of pollutants in the water are to be monitored and reported, and other provisions.

Under their stormwater programs, communities use best management practices, or "BMPs," that are recognized techniques for improving water quality. Some of these are described in this guide as being central to flood mitigation as well. Some BMPs for stormwater management are:

- Using buffers
- Planning
- Installing riparian (stream-side) zone protection
- Minimizing land disturbance
- Maximizing open space
- Installing wet ponds
- Establishing wetlands
- Using filtering practices
- Building open channels for storage
- Using infiltration measures
- Planting vegetation

The NPDES stormwater regulations now apply to all stormwater systems that serve more than 100,000 people and to smaller ones that are located in urbanized areas or are designated by the state or EPA as being subject to the regulations. Construction sites larger than one acre are also required to have NPDES permits.

For more information, see http://cfpub.epa.gov/npdes/.

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This project improved the carrying capacity of the channel and protected some of the banks, but had an adverse effect on the natural functions of the stream and created new maintenance costs for the community.

Modifying the Drainage System

Methods for modifying the drainage system focus on its two main components: conveyance and storage facilities. Because the purpose of drainage ditches and storm sewers is to safely convey water downstream, modifications to conveyance are recommended only where the receiving stream or river has sufficient capacity to receive the increased volume of water. To minimize the cumulative downstream flood impacts that may result from multiple small drainage projects, more detention or runoff reduction techniques should be considered along with the channel or storm sewer improvements.

Remember that the drainage system serves many purposes. Modifying it for one purpose—flood protection—can have adverse impacts on its other purposes. As noted on page 8-4, a natural stream carrying more flow will often result in bank erosion and accompanying sedimentation. Water moving out of the area too quickly can inhibit the natural process of filtering out pollutants. Altering the channel with rock or concrete will damage or destroy habitat and the aesthetic value a stream provides to adjacent property owners.

Channel Modifications

Four types of channel modifications are usually used to reduce localized flooding: channelization, vegetated swales, dredging, and increasing conveyance at stream crossings.

Channelization. Channelization means straightening, deepening, and/or widening a ditch or drainageway. It is important to emphasize some concerns about this approach.

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Channelization project.

- Channelized streams can cause or worsen flooding problems downstream because more water is transported more efficiently and often at a faster rate.
- Channelization projects destroy habitat (see bottom photo, this page).
- Channelized streams rise and fall faster than natural ones. When the weather is dry, the water level in the channel is often too low, which can diminish water quality and degrade the stream-side and aquatic habitat.

- Channelized waterways need more frequent maintenance to ensure that they keep their carrying capacity (see illustrations on page 8-3 and top photo on facing page).

Vegetated swales. A vegetated swale is an open channel that is used to convey stormwater in place of conventional ditches or storm sewers. Swales are also used to treat stormwater runoff by using native vegetation to filter pollutants.

Vegetated swales have advantages over traditional concrete-lined ditches or storm sewers:

- They are less expensive to build (although they may take up more surface area);
- They are less expensive to maintain;
- They more closely preserve the natural hydrologic characteristics of the drainageway; and
- They clean the stormwater by filtering it through the vegetation.

Drainage system modifications can be combined with wetland creation, vegetated swales, infiltration trenches, and other best management practices that increase infiltration (reducing runoff) and improve water quality.

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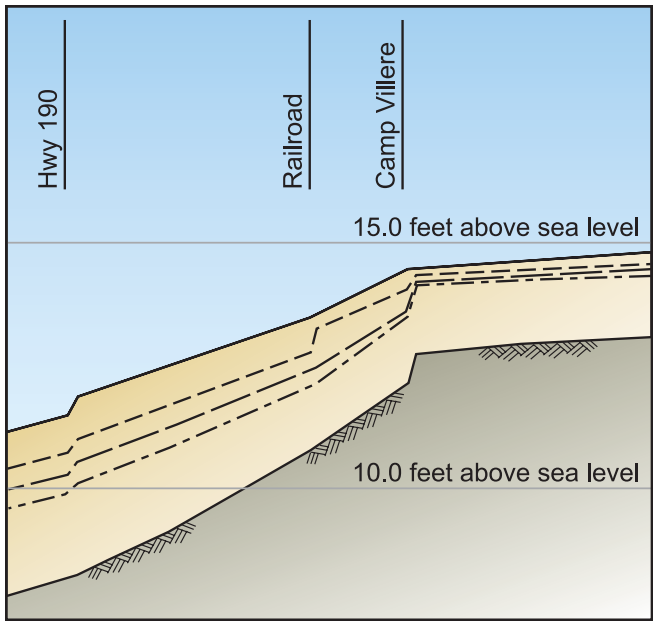
Drainage modifications do not have to be concrete channels. They can include measures to improve infiltration and water quality.

Dredging. Dredging involves the excavation of the channel bottom. It is often requested by residents who believe it will increase channel conveyance, but it poses these problems:

- Given the large volume of water that comes downstream during a flood, removing a foot or two from the bottom of the channel may have little effect on reducing flood heights.

- Dredging is often cost-prohibitive because the dredged material must be disposed of somewhere.
- Steeper side slopes increase bank erosion.
- Unless in-stream and upstream erosion problems are corrected, the dredged areas usually fill back in within a few years, and the process and expense have to be repeated.
- If the channel has not been disturbed for many years, dredging will destroy the habitat that has developed.

To protect the natural values of the stream, there are many places where Federal law requires obtaining a Section 404 permit from the U.S. Army Corps of Engineers before dredging can proceed. This can be a long process requiring advance planning and many safeguards to protect habitat (which adds to the cost of the project). In general, dredging a length of a channel is usually not recommended, although removing siltation at an obstruction, such as a bridge, may be worthwhile.



Adapted from St. Tammany Parish Flood Insurance Study

A profile is a side view of the elevations of a channel bottom and the various flood levels. This profile shows that on this tributary to Bayou Liberty, the Camp Villere Road causes nearly a one-foot increase in flood heights during smaller flows at the place where it crosses the waterway.

Stream crossings. Undersized stream crossings are a frequent problem in stream systems. An undersized culvert or bridge opening constricts flows and causes localized backwater flooding. One way to identify such places is to check the flood profiles, which are graphic portrayals of flood elevations that can be found in the community's Flood Insurance Study or local flood studies. Obstructions that back up water appear as stair steps on the graph (see illustration).

A common solution to these problems is to enlarge the culvert or bridge opening. In some cases, the existing culvert may act as a dam and provide flood storage upstream of the road. Increasing the culvert openings will reduce the flooding upstream; however, it will also allow more water downstream. Project plans need to ensure that the projects do not make flooding worse somewhere else and do not result in scour at the bridge or culvert.

As noted on page 2-6, the Village of Orland Hills was faced with undersized and deteriorating culverts. After a flood in 1996, the Village applied for and received disaster assistance funds to repair them. In the process, the culverts shown in Figure 2-2 (page 2-6) were replaced with larger openings.

Storm Sewers

Storm sewers can be an effective means of conveying local drainage and discharge into a receiving stream or a stormwater management facility. Flow capacity in storm sewers can be increased by installing new sewers, enlarging pipes, and preventing

back flows. Storm sewers are commonly designed to handle smaller storms and may not be effective for larger storms, such as the 100-year storm. Therefore, overland flow paths should be provided that will protect surrounding buildings from damage during a large storm.

The advantage of converting an open channel to a storm sewer is that it creates more useable ground surface. It can also reduce maintenance problems, because it is harder for debris to get into the pipes and clog the flow of water.

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Although piping a ditch makes more room for surface use, where will the excess water go? This pipe can carry only a fraction of the water that can be carried by the ditch.

From a flood protection perspective, piping ditches and storm sewers has some drawbacks:

- A big problem is that a pipe cannot expand. What happens to the water from a 10-year storm when a pipe is designed to carry only the 5-year flow? A good system design needs to ensure that overflows can be diverted to the street and not to buildings.
- Pipe openings and storm sewer inlets need to be kept clean so the water can get into the pipes.
- Installing pipe is an expensive activity, although it can save maintenance costs in the long run and reduce the potential for accidents or injuries that can occur in open channels.

Converting an open channel to a storm sewer should be done only if there are arrangements for handling potential overflow, either through a swale over the pipe or through streets.

Storm sewers are designed to carry runoff from an area to a receiving body of water. Sometimes the receiving body of water is at flood stage and the storm sewers back up, flooding the area that they are supposed to drain. If an area analysis concludes that backflow is one of the causes of localized flooding, a gate or valve can be installed to prevent storm sewer backup.

Levees and Floodwalls

Levees and floodwalls protect properties from flooding by keeping high flows within the channel, away from development in the floodplain. While dredging and channelization may make the channel deeper, levees and floodwalls, in effect, make the channel's banks higher.

Levees are barriers built of earth, and a floodwall is usually concrete, masonry, or sheet piling. Floodwalls perform the same function as levees, except they are vertical-sided structures that require less surface area for construction.

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A small floodwall can protect against smaller, more frequent floods.

Both structures must be properly designed to account for large floods, underground seepage, pumping of internal drainage, erosion, and scour. Key considerations when evaluating use of a levee or floodwall include:

- Should fill be removed to compensate for the floodwater storage that will be displaced?
- Will the structure divert flood flows onto other properties? (Because of this hazard, levees and floodwalls are not allowed in the regulatory floodway in the mapped Special Flood Hazard Area.)
- How will the project handle drainage of the surface flows in the area protected by the levee?
- What will it cost to construct?
- What will it cost in the future to maintain?
- Will people object to having their river access and views restricted?
- Will people have a false sense of security? (Although levees may reduce damage for smaller, frequent rains, they may also be overtopped or breached in extreme conditions and then create more flood damage than would have occurred without the levee.)

Levees or floodwalls placed along the edge of a river or stream may degrade the aquatic habitat and water quality. They also are likely to push floodwater onto other properties upstream or downstream.

To reduce environmental impacts and provide multiple benefits, a setback levee is sometimes used. The area between the levee and the channel can provide open space for recreation and provide access sites to the river or stream.

Storage Improvements

Storage improvements should be located upstream of the flood problem area, although there are some limitations on what can be done in the drainage system of an already built-up area. There are two kinds of storage facilities: regional and on-site. Regional basins or reservoirs collect and store the excess runoff from many properties and are typically larger than on-site basins.

On-site storage basins manage the stormwater from the site where it originates. These smaller basins are usually constructed when the development is built and can be designed to address water quality concerns as well. Chapter 4 discusses stormwater management regulations that require such basins. Later in this section, on-site features are discussed that individual property owners can implement to reduce their runoff.

Regional facilities. Larger regional storage basins are often called reservoirs. Reservoirs can be dry and remain idle until a large rain. Or they may be designed so that a lake

The Town of Hilton Head Island, South Carolina, conducted an Island-Wide Drainage Study in 1995 to identify existing drainage improvement needs. The study recommended channelizing the natural freshwater creek upstream of Jarvis Creek and upgrading the stormwater outfall. According to the original drainage plan, the freshwater creek would be enlarged to a bottom width of 35 feet and a depth of 6 feet. This project would destroy approximately 4 acres of freshwater wetlands.

In 1996, the Town negotiated the purchase of the 50-acre Jarvis Creek Tract, which is adjacent to the existing Jarvis Creek ditch and was privately owned. An alternative plan was developed: a 10-acre lake would be capable of storing and conveying the necessary stormwater. A pump station was installed that moved water from the ditch to the lake. From the lake, water would flow through a vegetated spillway that discharged into the headwaters of Jarvis Creek.

By selecting this storage approach over the channelization project, 3.5 acres of freshwater wetlands were protected and upland habitat and tree loss was reduced. In addition to being a drainage improvement project, the Jarvis Creek Project was designed to be a community park.

Town of Hilton Head Island

or pond is created. The lake may provide recreational benefits or water supply.

In urban areas, some reservoirs are simply human-made holes, excavated to store flood waters. Some communities have converted quarries and sand pits to temporary storage basins. If they are built into the ground, there is no dam for these basins and no dam failure hazard. Wet or dry basins can also double as parks or other open spaces.

There are several considerations when evaluating use of reservoirs and storage basins:

- Floods can threaten the protected area if the reservoir's dam fails;
- The expense for management and maintenance of the facility;
- Reservoirs and basins may fail to prevent floods that exceed their design levels, which are typically less than a 100-year event;
- Sediment deposition may occur and reduce the storage capacity over time;
- Water quality (both positive and negative) can be affected due to altered temperature, dissolved oxygen and nitrogen, and nutrients; and
- If not designed correctly, in-stream reservoirs may cause backwater flooding problems upstream.

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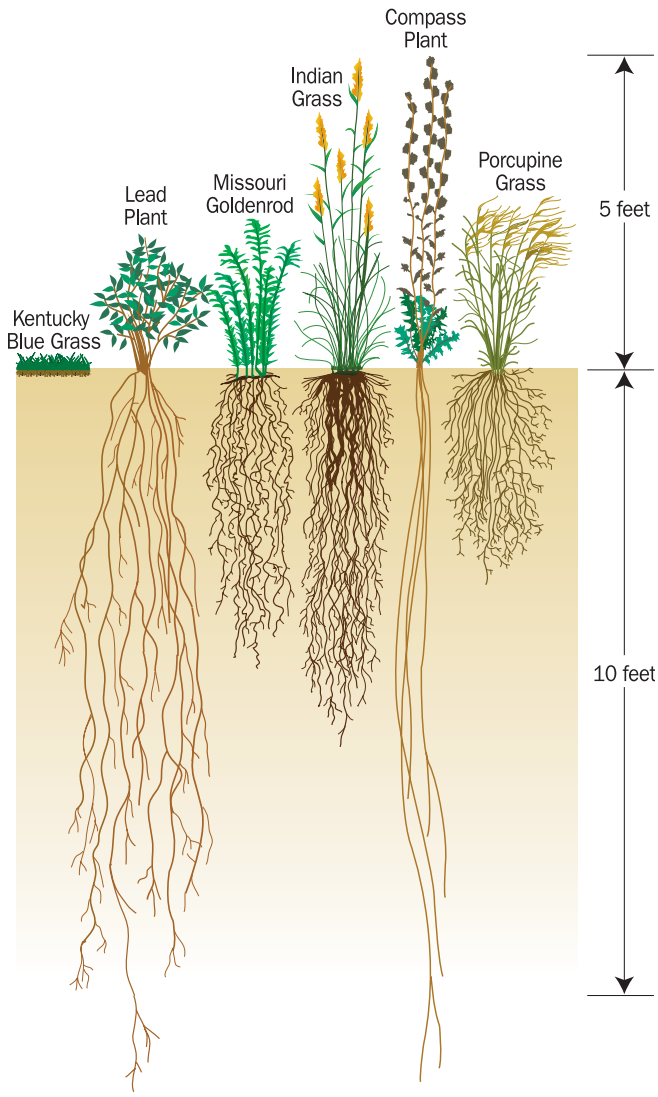
This storage basin adds a water amenity to this office park and protects downstream properties from high flows.

On-site storage improvements. Most on-site storage facilities are constructed to meet the community's subdivision or other development regulations. These regulations are covered in Chapter 4.

In areas that are already developed, large basins are not likely to be feasible. However, some improvements can be made when a parcel is redeveloped, and some can be initiated by interested owners that will reduce the amount of runoff leaving an individual residential or commercial property. Although such techniques will not appreciably diminish runoff from a large storm, their cumulative effect may reduce flooding problems for small storm events. They do improve water quality at a local level and have the added advantage of raising neighborhood awareness about water quality and quantity. Some examples include:

- Using open brickwork or porous paving when replacing a driveway or parking lot (although proper construction and maintenance are needed to keep the surface porous);
- Replacing lawns with native plants that have deeper roots that improve filtration;
- Installing rain barrels that collect and hold rainwater in large receptacles for lawn and garden watering. This reduces the owner's water bill and reduces the runoff during and after a storm; and
- Building rain gardens. These are landscaped areas planted with wildflowers and other native vegetation that soak up rainwater, mainly from the roof of a house or other impervious areas. Rain gardens, which incorporate special design features, allow approximately 30 percent more water to soak into the ground than a conventional patch of lawn.



Compare the root system of Kentucky blue grass with native prairie plants. The value of native ecosystems to absorb and hold stormwater can be a useful tool in reducing floods in urbanized areas.

Projects like rain barrels and rain gardens can be a valuable part of the community's effort to reduce stormwater runoff and meet its NPDES goals of improving water quality. Although an individual rain garden may seem insignificant, many collective rain gardens and an active rain garden program can produce substantial neighborhood and community environmental benefits and a constituency interested in, knowledgeable about, and committed to improving the area's drainage system.

Rain gardens yield many benefits:

- They increase the amount of water that filters into the ground, which recharges local and regional aquifers;
- They help protect streams and lakes from pollutants carried by urban stormwater—lawn

fertilizers and pesticides, oil and other fluids that leak from cars, and numerous harmful substances that wash off roofs and paved areas;

- They enhance the beauty of yards and neighborhoods; and
- They provide valuable habitats for birds, butterflies, and many beneficial insects.

Rain gardens take careful planning and won't work everywhere. The design needs to account for soil types, standing water that may breed mosquitoes, potential damage by vehicles or children, and similar concerns that arise when a new technique is introduced.

Prince George's County, Maryland, Stream Teams, a valuable part of the community's stormwater program, includes a citizen volunteer monitoring program and has held several workshops called "Planting a Rain Garden for Community Service Day" and "How to Make a Rain Barrel." Both workshops were free and open to the public. Free native flowering plants were given to all participants for the Rain Garden workshop and a free rain barrel to each participant at the Rain Barrel Workshop.

At a Rain Barrel Workshop, about 15 people met in the West Laurel Civic Building for a 30-minute demonstration. Representatives from the state Department of Environmental Resources showed the participants how to assemble the rain barrel and answered questions.

Maintaining the Drainage System

A community's drainage system covers a large area and includes storage basins, stream channels, backyards, swales, ditches, and culverts. A regular program of drainage system inspections can catch problems in the system before they turn into major obstructions. Such inspections and follow-up work for the whole drainage system can be quite daunting, so this section breaks the work down into four levels of effort:

- Maintaining the public drainage system;
- Involving citizens in the process;
- Regulating against dumping and other actions that will adversely affect the system; and
- Maintaining the yard.

Maintaining the Public System

The public part of a drainage system varies from community to community. Normally, the larger streams, drainage ditches, and channels on public property are maintained by the local government. Storage basins that have been dedicated to the community also are part of it. Some communities do not accept maintenance responsibility for new storage basins, leaving that up to the property owner.

Government agencies usually accept responsibility for maintaining bridge openings and facilities on public property. However, in most areas, the responsibility for drainageway maintenance on private property, where no easements have been granted, is with the individual private property owner. This often results in very little maintenance being accomplished. A community that wants to improve the care of its streams should have a campaign to urge owners to sign easements allowing local staff access for inspections and maintenance.

Dr. Warren Campbell

A regular inspection and maintenance program can remove debris before it becomes an obstruction to stream flows.

As outlined in the CRS, at a minimum, the maintenance program should:

- Inspect the entire drainage system at least once each year;
- Check known problem sites during or immediately after heavy storms;
- Respond to inquiries or complaints from citizens; and
- Remove debris soon after it is found.

In Activity 540 (Drainage System Maintenance), the CRS encourages and provides credit for:

- A formal program that inspects channels and storage basins and removes debris;
- A capital improvements program that provides an annual budget for channel and basin improvements; and
- Stream dumping regulations.

"Debris" refers to a wide range of materials that may obstruct flows so that a small storm will cause an overbank flood. Debris may include tree limbs and branches that accumulate naturally, large items of trash or lawn waste accidentally or intentionally dumped into channels, drainage swales, or storage basins. Maintenance of storage basins may also require revegetation or repairs of the restrictor pipe, berm, or overflow structure.

All communities are encouraged to have formal procedures for maintaining their part of the system. Sometimes it is a very fine line that separates debris that

should be removed from natural material that helps form habitat. Therefore, written procedures that are consistent with state laws and environmental concerns (such as the NPDES guidelines) are especially helpful.

Guidelines on designing a program, along with model procedures, can be found in *CRS Credit for Drainage System Maintenance*.

Citizen Involvement

An annual inspection by a public agency means that for most of the year, the inspection or maintenance crew does not see the stream or basin. Involving the citizens can be very helpful. While they may not do any maintenance (especially removing large logs or obstructions), citizens are the eyes and ears of the community and can look out for and report problems before they cause a flood.

Some communities have organized "stream teams" that regularly monitor assigned sections of rivers, streams, and canals and report when problems are found. Some of these team members are trained to know what to remove and what not to touch, so they can do some minor work during their inspections.

Many communities leave storage basin maintenance up to the property owner or homeowners association, people who are often not knowledgeable about the technicalities of basin maintenance and who may not have the resources to properly care for them. To counteract this, some communities have assumed responsibility for inspecting all basins on private property. If a problem is found, the owners are required to correct it.

Mandeville's Drain Team

A group of 38 volunteers formed the **City of Mandeville, Louisiana**, Drain Team. The Drain Team assists the Department of Public Works by monitoring over 150 miles of drainage arteries in their neighborhoods. These citizens clean debris from the ditches and catch basins during wet and dry weather. Members receive yellow rain suits with the City of Mandeville insignia on them to help keep them dry while monitoring the drainage.

Monthly and quarterly meetings are held with these members and with the City staff for regular updates. "You just wouldn't believe what an impact this team has on keeping the water flowing during storms. Their biggest job is keeping the balls and garbage can lids out of the culverts," said Mr. Glenn Craddock, Assistant Superintendent of Streets and Drainage.

FEMA (2002, pp. 25–26)

Other communities have implemented training programs for homeowners associations and other basin owners. Some have published guides for individuals who live along a stream and for owners of stormwater facilities.

Regulating Dumping

An anti-dumping program can reduce drainage problems and the workload of the maintenance crews. Nuisance ordinances in many communities prohibit dumping garbage or other objectionable waste on public or private property, but dumping still occurs.

Non-objectionable materials, such as grass clippings or tree branches that can kill ground cover or obstruct drainage channels, also should be covered by the dumping ordinance. A community can schedule regular inspections to catch violations. Sample language for an ordinance can be found in *CRS Credit for Drainage System Maintenance*.

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Stream dumping notice.

A dumping enforcement program should include public information materials that explain why the rules are in place and what the penalties are. This program is essential because many people do not realize the consequences of their actions. They may fill in the ditch in their front yard, not realizing that it is needed to drain water running off the streets. It may not be clear to them that regrading their yard, filling a wetland, or discarding leaves or branches in a stream or ditch can cause flood problems.

Yard Maintenance

Yards are part of the drainage system. Subdivision and building plans should have the main structure elevated on a building pad. The side and back yards should be preserved as conveyance areas to carry water away from the building and to the storm sewers, streets, or receiving ditches or streams.

Many people do not realize the importance of keeping the yards and swales clear. When people build fences, garages, sheds, and swimming pools or plant trees that disrupt the drainage patterns, surface water will be pushed onto other properties or even flow back and into the owner's house (see the photograph on page 4-20).

A local government can do two things to preserve yard drainage. The first is to inform the public about the importance of yard maintenance, keeping the drainageways open, and reporting problems to the authorities. Most people will not obstruct flows if they understand how obstructions can adversely affect them and their neighbors.

The second action is to enforce the dumping regulations and drainage easements. Most survey plats show easement boundaries, and public information programs can help to educate property owners about the laws against stream dumping and the easement regulations and restrictions.

Where to Get Help

- U.S. Army Corps of Engineers (for larger levee and channel modification projects).
- More information on Corps of Engineers' 404 permits can be found at http://www.nwo.usace.army.mil/html/od-tl/introductionto404.html.
- Natural Resources Conservation Service (for larger levee and channel modification projects).

Additional resources are listed in Appendixes A and B.

9

Redevelopment

An analysis should be conducted of localized flood problems (see Chapter 7) to identify actions that would be appropriate on an area-wide basis. The analysis would determine whether a local drainage project is feasible (see Chapter 8), whether redevelopment of all or parts of the area would be suitable, or whether the localized flood problem should be dealt with on an individual building basis (see Chapters 10 and 11).

As stated in Chapter 1, the term "floodplain" is used in this guide in a general sense to mean the area most prone to flooding, be it mapped or unmapped. The floodplain for a localized flood problem may well not be mapped as a Special Flood Hazard Area (SFHA) on the community's Flood Insurance Rate Map (FIRM).

As used in this guide, redevelopment means taking deliberate steps to convert the use of a parcel or a neighborhood to a new use that is more compatible with environmental factors (including flooding), more economically productive, or more beneficial to the community fabric. Redevelopment is more than just flood mitigation. It looks to the future and what will happen to the land, and what that will mean to the community.

Redevelopment Objectives

A redevelopment project could be pursued for several reasons:

- The area analysis may conclude that a change in use of the area is the best way to reduce the localized flood problem.
- A fire, flood, or other hazard may damage buildings and necessitate reconstruction.
- A change in the local economy, such as the closure of a major employer, may trigger a need to redevelop an area to attract or pursue new economic opportunities.

- A flood-prone area may have deteriorated to such a state that buildings need to be torn down to correct unsafe or unhealthy conditions.

For whatever reason buildings are removed or rebuilt, redevelopment is an opportunity to remedy a localized flood problem and work toward other community goals.

Floodplain Management Objectives

There are several floodplain management benefits to clearing a flood-prone area for redevelopment:

- After clearing, there will be no buildings subject to flood damage. Existing damage-prone buildings will have been moved away or demolished and, if replaced, the new buildings should be constructed to be protected from flood hazards.
- A vacant area will provide more room to carry or store flood waters, reducing the hazard upstream and/or downstream.
- A reduction in urban use of the area will increase opportunities for riparian habitat, i.e., habitat for plants and wildlife that live near or depend on water.
- The absence of buildings and other urban features that need protection would allow the stream channel to seek its natural course, potentially reducing public expenditures on bank stabilization projects.

The greatest floodplain management benefit is to remove the greatest cost of flooding—damage to buildings, especially buildings that are repetitively flooded. The community can consider buying these buildings and clearing the sites. Additionally, there are Federal and State programs to finance buy-outs, and the mechanics of participating in an acquisition program are covered later in this chapter.

Acquisition of flood-prone properties is becoming more and more common, but a community needs to think beyond a single flood protection objective. It needs to consider other factors, including:

- What will happen to the current occupants, either residents or businesses?
- How will the land be used and maintained after it is cleared?
- How will this affect adjacent properties and the rest of the neighborhood?
- How will it affect other goals and objectives of the community?

Because of these concerns, an acquisition program should not be initiated without considering the full impact of redevelopment on the neighborhood and the community.

Non-Flood Objectives

One of the advantages of choosing redevelopment as a solution to a localized flooding problem is that the project can also help meet other needs or objectives for the neighborhood and/or the community.

The community planning process described in Chapter 3 and the area analysis (Chapter 7) should include a review of community and neighborhood goals and objectives for the area. Broader statements of vision and goals may be found in the comprehensive plans, hazard mitigation plans, or regional watershed plans. For example, a watershed plan may identify natural areas that are to be preserved by acquisition and easements when an opportunity arises.

Opportunities for cooperation and sharing resources with others interested in non-flood objectives should be a top priority for community floodplain managers. Coordination with other people, goals, and objectives has the following advantages:

- **Avoiding conflicts.** Coordination ensures that flood mitigation activities do not conflict with other plans for an area. For example, if a community wants to increase recreational opportunities, clearing out flood-prone structures to create a waterfront park would be a good use of resources. On the other hand, if a community is interested in economic development, the redevelopment strategy should consider approaches that do not reduce the community's economic base.
- **Sharing resources.** Limited funds and resources may be shared to accomplish common goals. As an example, programs that fund park development might be used to defray the costs of acquiring flood-prone properties.
- **Maintaining interest.** Concern about flood protection wanes over time, particularly during a dry spell. If redevelopment is linked to other community initiatives, such as economic development, education, and recreation, it has a better chance of reaching completion.
- **Meeting funding requirements.** Many funding programs require applicants to coordinate with other agencies, exhaust other sources of funding, or bring other agencies in on cost-sharing.

Coordination with Other Objectives

There are several important advantages to coordinating with others to expand a flood-mitigation-focused approach into a redevelopment project that benefits everyone. The interest groups and organizations presented in this chapter should be contacted as plans are formulated. They should be invited to participate in the planning of a redevelopment project and, ideally, they will want to contribute time, support, or even money because the flood project will advance their objectives as well.

The planning and urban renewal departments of the community are the most important offices to bring into the redevelopment process. They probably already have plans or concepts of how an area should be redeveloped. Approaching them with flood-related redevelopment plans or providing funds to acquire some of the properties may be the catalyst for them to activate their own plans.

If the community does not have to make immediate decisions (e.g., if the area has just been flooded, and people are waiting to rebuild), time should be taken to integrate redevelopment of the area with other community objectives. Coordinating with the

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There is often widespread community support to replace run-down buildings with open space and recreational facilities that everyone can enjoy. Transportation planners support greenway sites to keep pedestrians and bikers separated from vehicular traffic. The Aldridge Creek Greenway is being expanded and extended over the years as the City of Huntsville, Alabama, acquires and clears flood-prone homes.

community planning office can help ensure that redevelopment of the area would be put in the capital improvement plan, land use plan, repetitive loss initiatives, waterfront revitalization plan, or economic improvement program. Other objectives may include those discussed below.

Recreation. People with interests in recreation are the most obvious supporters of a project to clear and reuse land next to a body of water. Replacing flood-damaged buildings with open space or a linear parkway can be very popular and supported by many different people who would benefit.

> ***Redevelopment objectives.*** Establishing parks, ball fields, ice skating rinks, hiking and biking trails, picnic areas; dedicating sections for fishing, hunting, bird watching, and sightseeing.
>
> ***People to contact.*** Parks and recreation department; environmental organizations; nearby schools (interested in expanding athletic fields or educational opportunities); land preservation organizations (e.g., The Nature

Conservancy, The Land Trust Alliance); conservation and outdoor groups (e.g., Izaak Walton League, Audubon Society, Boy and Girl Scouts and other youth groups); hunting and fishing organizations (e.g., Ducks Unlimited, Trout Unlimited); recreational businesses (e.g., marinas, sporting goods stores).

Fish and wildlife. Preserving open space and restoring waterways, ponds, and wetlands are prime goals of the supporters of fish and wildlife. Clearing development back from streams, wetlands, and shorelines protects important habitat.

Redevelopment objectives. Expanding habitat; improving water quality (e.g., filtering runoff from parking lots or industrial areas through wetlands, grass, and/or planted open spaces); reducing or eliminating the need for channelization and other alterations to habitat.

People to contact. State fish and wildlife agencies; U.S. Fish and Wildlife Service; Federal and State environmental protection agencies; Natural Resources Conservation Service; parks departments; land preservation organizations; conservation and outdoor groups; hunting and fishing organizations.

Economic development. Some of the strongest community concerns are those that relate to the local economy: jobs, business survival and expansion, tax base, and viability of shopping areas. In many communities, the economic base was founded on or is dependent upon the waterfront.

Sometimes, economic development is seen as contrary to good floodplain management—why put businesses in a hazardous area? Coordinating with development interests assumes that new development will meet (or preferably exceed) the National Flood Insurance Program (NFIP) requirements for floodplain development. For example, the areas of deepest flooding can be preserved as open space while new buildings are elevated 1 or 2 feet above the regulatory flood elevation.

Redevelopment objectives. Redeveloping or reusing vacant or abandoned businesses; improving the appearance of the neighborhood adjacent to businesses and stores; improving access to parking and services along the waterfront; providing open space, picnic tables, and other recreational opportunities for employees; improving facilities that would attract tourists; retrofitting certain types of commercial structures, such as garages and car washes, to resist flood damage and support nearby businesses.

People to contact. Local and State economic development and job training agencies; chambers of commerce and business or manufacturers' organizations; real estate organizations; U.S. Economic Development Administration; community development and planning offices; recreational businesses (e.g., marinas, sporting goods stores, restaurants, hotels); utility companies; others that serve business and industry.

Housing. If the local flood problem area includes houses, the floodplain manager need only remember that every homeowner and renter wants a better place to live.

Residents and the organizations that work to improve housing can be vital allies to a redevelopment project.

Residents can even provide financial support for a project. Well-insured flood victims have used their claims payments and Increased Cost of Compliance payments (see page 11-6), their own labor, and/or additional funds to meet the non-Federal match of an acquisition project. Homeowners will work hard to replace their flood-damaged or deteriorating homes with new and better ones.

Redevelopment objectives. Removing vacant, abandoned, or dilapidated housing; bringing housing up to safe and sanitary conditions; providing affordable housing; improving recreational opportunities for nearby homes; improving property values; providing housing adjacent to amenities, such as parks, greenways, and natural areas.

People to contact. Community development, planning, and code enforcement offices; local housing authorities; neighborhood associations; and builders or developers associations.

Historic preservation. Historic features include buildings, museums, archeological sites, historic landscapes, and collections. These features are irreplaceable. Most people responsible for their preservation or restoration recognize that if these features were hit by a flood or other disaster, a valuable community and educational asset would be destroyed. Even minor problems, such as a flooded basement, high humidity, or loss of power, can severely damage delicate or aged materials.

Every application for Federal Emergency Management Agency (FEMA) acquisition funding requires a historic preservation review, so involving the appropriate personnel early in the planning is beneficial and practical.

Redevelopment objectives. Protecting historic properties; improving and opening areas surrounding a historic site (to help it conform to its original setting).

People to contact. Local historical societies; museums; school and university history departments; parks and recreation departments; State historic preservation office.

Public works. Repetitive flooding can contribute to deterioration and maintenance problems for streets and other components of an area's infrastructure. Water, gas, sewer, and power lines are sometimes broken due to settling of the organic soils found in flood-prone

Rebuilt Areas Produce Many Benefits

Frankfort, Kentucky, developed a flood hazard mitigation plan to cover areas that were not scheduled to be protected by a planned floodwall. The areas included residential, commercial, and industrial uses as well as historic buildings. The high-velocity floodway has been cleared.

Funding support came from the Federal Emergency Management Agency, the U.S. Department of Housing and Urban Development, the Kentucky Housing Corporation, Frankfort Housing Redevelopment, Inc., and Habitat for Humanity. The last three groups helped obtain replacement housing for those whose properties were bought out.

There were several important spin-off benefits from the project:

- Reduction in the number of buildings exposed to flooding;
- Increased open space and recreation opportunities;
- Improved housing for residents relocated from substandard homes;
- Improvements to non-flood-prone houses that were purchased and improved to meet safety criteria as replacement homes;
- Training programs for the youths who helped rehabilitate replacement homes; and
- Increased property values of the surrounding area.

Association of State Floodplain Managers (1996, p. 35)

areas and wetlands. Public works, street, and highway departments are faced with repairs and are under pressure to upgrade roads and bridges to provide continued access to flooded areas. Public works staff are often supportive of redevelopment plans to reduce the amount of their infrastructure in a flood-prone area.

Redevelopment objectives. Lowering maintenance and replacement costs; reducing work during a flood; creating alternative transportation modes (such as bikeways and trails); reducing exposure of the sanitary sewer system to inflow and infiltration.

In the 1970s, **Baltimore County, Maryland,** set aside $5 million to enlarge and improve flood-prone bridges. The county planners calculated that it would be cheaper to purchase and clear the flood-prone buildings served by the bridges than to replace the bridges. The County subsequently implemented a nationally recognized acquisition program and saved money in the process.

People to contact. Local public works, streets, water, and sewer departments; utility companies; regional or metropolitan sanitary districts; community development, economic development, and planning office.

Clearing the Area

Removing structures and infrastructure from a flood-prone area is one approach to acquiring land for redevelopment. If open space or growth control is a community objective, then purchasing land, clearing it, and keeping it undeveloped is appropriate. If flood-prone properties are to be acquired, then several steps should be taken to ensure the desired outcome, whether it's open space or redevelopment. The properties should be assessed for repetitive losses and their proximity to other potential buy-out properties. It is advantageous to purchase contiguous properties to provide more options for re-use. Once the properties are identified, damage-prone buildings should be removed and the area maintained as publicly owned open space or redeveloped, as discussed later in the chapter.

Many communities today have ongoing buy-out programs to gradually acquire flood-prone lots throughout their jurisdictions, as the opportunities arise.

Acquisition Funding

The biggest hurdle to redeveloping a flood-prone area is the cost of acquiring the properties. Several possible funding sources can be pursued.

- **Community general funds.** The Village of Gurnee set aside funds in its operating budget to acquire one or two properties each year as they came up for sale (see photos on next page).
- **Community capital budget.** A capital budget is often funded by a bond issue or special tax. It is used for permanent improvements to the community, such as drainage projects and parks acquisition.
- **Environmental or open space organizations.** The Nature Conservancy, the Trust for Public Lands, and other, more local, organizations are often interested in acquiring land for open space preservation.

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Over the years, the **Village of Gurnee, Illinois,** acquired and cleared homes in this repetitively flooded area. Some were purchased with funds from FEMA, but others were purchased by the Village when they were put up for sale by the owners. One area is now a public park for all residents to enjoy.

- **Adjacent property owners.** A factory, a school district, or another property owner interested in expanding may provide financial support. The land could be reused for parking or athletic fields to support the owner. If the nearby owner is considering redevelopment or expanding in a different direction, the flood-prone area might help meet regulatory requirements, such as the open space lot ratio or stormwater detention.
- **Private developer.** Depending on the location, a private developer may well be interested in purchasing, clearing, and redeveloping an area. It may not become open space, but the new development should take the flood hazard into account.
- **State and Federal grants.** Community development, open space, parks, natural resources, and housing agencies may have funds that can be used for different purposes, such as acquiring land needed for a public purpose. The most commonly used funds are those from FEMA, which are discussed in the next section.

FEMA Funding

Three FEMA programs can fund acquisition of floodplain properties: the Hazard Mitigation Grant Program, Flood Mitigation Assistance, and the Pre-Disaster Mitigation program. All three are managed by the State, usually the emergency management agency. In addition to Federal requirements, States may also set additional priorities for use of the funds. Eligibility requirements for these programs may change, so contact your local administrator for current requirements.

Recipe for a Successful Acquisition Project

There are several sources of funds to purchase and clear flood-prone property. Getting the money is only half the job. The community needs to coordinate with many different parties and do some work on its own. Here are the key ingredients.

- **Commitment by the leadership.** The community has to be ready to commit staff time and political support for what may be a long and involved process.
- **Commitment by the staff.** If the staff has the necessary expertise and can handle the workload, some services can be done in-house. Otherwise, some communities will need to contract out services, such as project management, appraisals, legal services, and/or demolition.
- **Property owner involvement.** A successful mitigation project requires active and willing property owner participation. Even though they may have experienced recent damage, property owners may not always like the idea of selling and moving. Mitigation funds from FEMA are strictly limited to voluntary participation. The process should include a signed statement from each property owner that his or her participation is voluntary.
- **Informed public.** The community should have an effective communication plan and be committed to making it work. It is not just the owners of flood-damaged homes who are affected. Nearby residents and others throughout the community will be interested and will need to be kept informed.
- **Lots of data.** The community will need to collect data about each property. Owners should sign documents to allow access for the purpose of appraising property values and estimating damage. A title search must be conducted to ensure that the title to the property is clear of encumbrances such as ownership issues, probate, or contractor liens.
- **Clear and fair procedures.** The community must establish the basis for deciding property values and the amount of money property owners will receive. A licensed appraiser is needed to prepare fair market valuations. Experience shows property owners will talk to each other about their offers, so it is important that clear policies are established up front and applied uniformly. When owners believe the appraisals are not accurate, they need to be able to appeal the decision about their own appraisal.
- **Adjusted purchase price.** If FEMA funds are involved, flood insurance and disaster assistance payments to the owners need to be deducted from the purchase price if the money was not used to repair the building. This prevents what is called "duplication of benefits." If an owner wants to remove items after the appraisals have been made, the value of the items is deducted from the purchase price.
- **Demolition and clearance.** FEMA rules require that acquired buildings be demolished within 90 days of closing. Communities have found it more efficient to clear several lots at the same time. Wells have to be capped and septic tanks handled according to state regulations.
- **Paperwork.** Required paperwork includes records of meetings with the owners, copies of the appraisals, title insurance policies, warranty deeds, closing statements, and the checks for all disbursements. The state will perform a field inspection before approving final disbursement. All paperwork must be in order and kept until FEMA closes out the project.

Hazard Mitigation Grant Program (HMGP). HMGP funds are made available after a Presidential disaster declaration. The amount of funding available varies based on the total amount of expected Federal disaster assistance (the costlier the disaster, the more HMGP funds there will be). Eligible projects may be funded throughout the State, not just in the damaged area.

Flood Mitigation Assistance (FMA). FMA funds come from fees paid by NFIP policyholders and are used to reduce flood damage and repetitive losses to buildings insured under the NFIP. Each year a certain amount is set aside for planning grants, project grants (e.g., acquisition of property), and technical assistance grants. FMA funds are allocated to the States and territories based on certain criteria, such as the number of repetitive flood loss properties and number of flood insurance policies.

Pre-Disaster Mitigation (PDM) program. Annual appropriations provide the funding for the PDM program. There is no State allocation or formula to distribute the funds. States and communities throughout the country can apply, but they compete with all other applicants from across the country. Projects that potentially have the greatest impact on reducing future losses are the most likely to receive the funds.

All three programs provide up to 75 percent of the eligible costs for acquisition and other mitigation projects. The non-Federal share can be from a variety of other local, State, or private funding sources. The Community Development Block Grant can also be used as a match. Property owners may contribute their own money or their insurance claim payment (see Increased Cost of Compliance coverage in Chapter 11) to help offset the cost of the project. A portion of the non-Federal match may be covered by in-kind or donated services.

All three programs have the following application requirements:

- The applicant must show that the benefits of the project exceed the costs (FEMA's benefit-cost analysis software is the best resource);
- The applicant must conduct an environmental review and obtain historical preservation clearance; and
- The community must have adopted a FEMA-approved mitigation plan (discussed in Chapter 3).

Clearing the Buildings

If there are buildings on any lots purchased through public acquisition projects funded by grant programs, including the FEMA programs, all of them must be cleared off the site within a certain time frame.

In Activity 520 (Acquisition and Relocation), the CRS credits acquiring, relocating, or otherwise clearing buildings from the floodplain. The community must document that the property will stay vacant.

Deteriorated structures, especially if they are abandoned, are health and safety concerns, and if the parcel has been converted to public ownership, it poses a liability for the local government. It is preferable to raze those buildings that have suffered repeated flooding and/or have been seriously damaged.

Buildings that are in usable shape may or may not be demolished, depending on the future use of the property and their location in relation to the expected flood water. However, these buildings may be obstructions to the flow, can inhibit drainage, and will take up space that might be better used as stormwater storage or for vegetation.

Hollis Kennedy House Movers

Smaller structures can be relocated and reused relatively easily, provided past flooding has not caused permanent damage or created health hazards. It is recommended that the walls be stripped and new, clean, insulation and wallboard be installed after the move.

Lake County, Illinois, Stormwater Management Commission

One inexpensive way to clear an acquired structure that is not a candidate for relocation is to offer the structure to the fire department for training and practice.

Some communities have moved the acquired building to a flood-free site and converted the structure to public housing on the new site. In other cases, the building owner moves the structure, sometimes to a new lot or sometimes to a part of the lot that is above the flood level.

The cost of relocating a building will depend on its size and construction type. It is easier and less expensive to move smaller, wood frame buildings on crawlspaces or basements than heavy structures made of brick with irregular shapes. Local house moving companies can estimate the cost and feasibility of moving a building. Some funding programs, such as the FEMA programs listed above and Increased Cost of Compliance (see Chapter 11), can help pay to relocate a structure.

Reuse of the Area

Redevelopment projects need to keep the flood hazard in mind when reuse of the area is being considered. The most popular use (and the use required by some Federal funding programs) is open space. Other uses compatible with the hazard are possible.

Public Open Space

If the area is being redeveloped as a park, preserve, greenway, or other public use, it will likely be owned by a parks or recreation agency. It is in the interest of the owning agency to keep it in a compatible open space use.

In Activity 420 (Open Space), the CRS credits keeping vacant flood-prone lands open by keeping the land publicly owned, keeping it as a private preserve, or regulating new development on the parcel. More credit is provided if the parcels are preserved in an undisturbed (or restored) natural state.

Parks. Parks are one of the best uses of flood-prone areas. Even with minimal investment, such natural areas provide opportunities for passive recreation as well as hiking, jogging, horseback riding, bird watching, and photography.

Greenways. A hiking or biking trail can greatly enhance the benefits derived from park lands. Planning such a trail will benefit from input from environmental and recreational interests who can help develop a safe, environmentally sensitive alignment. Many communities now have networks of greenways that incorporate trails, and it may be possible to link newly cleared flood-prone areas with them.

Public facilities. Other recreational facilities, including sports fields, golf courses, boat ramps, picnic and camping grounds, fishing docks, and open-air amphitheaters,

Greenways

- In an increasingly urban nation, greenways provide much-needed space for outdoor recreation and offer accessible alternatives to those who don't live near traditional parks.
- A greenway is ideally suited to such popular outdoor activities as jogging, walking, biking, fishing, and canoeing.
- Greenways provide safe, alternative, non-motorized transportation routes for commuters going to work and children traveling to and from school.
- Greenways offer ideal possibilities for joint-use partnerships along corridors with sewer, utility, and fiber-optic lines and railroad interests.
- In rapidly urbanizing areas, a greenway offers visual relief; its wooded breaks can frame and distinguish neighborhoods in an otherwise undifferentiated urban sprawl.
- Greenways are community amenities with an economic value. They enhance the quality of life and can increase the value of surrounding properties.
- Greenways have been shown to draw tourists and have been the catalyst behind new commercial development and the revitalization of former town centers.

Flink and Searns (1993, pp. 1-2)

French & Associates

The Village of Gurnee, Illinois, included a greenway as part of its flood mitigation plan.

French & Associates

Greenways offer recreation and transportation opportunities for everyone in the community.

are compatible with shallow flooding and have the potential to generate income for the community. The land could also be used for flood storage, either by keeping the overbank areas open or using the site as a storage basin for the watershed that drains to it.

Private Open Space

In some cases, the flood-prone land may stay in private ownership, for example, when:

- The community (or a nonprofit group such as the Nature Conservancy) purchases the development rights or an easement to keep an area open, but does not purchase full title to the property;
- The area is redeveloped by a private developer;
- Adjacent property owners want the site for parking or other private use that is compatible with flooding;
- The community has purchased and cleared lots and deeded them over to adjacent owners for maintenance; or
- The owner moves the structure to higher ground but does not want to part with the waterfront land.

These cases are often much less expensive than acquiring the entire property, but the community does not have complete control over the parcel. There is always a concern that owners will be tempted to build something inappropriate on their lots.

If the community acquired the lot or helped fund the acquisition, it has a right to attach an easement to the deed. Easements are legal restrictions to preserve some or all of a parcel as open space, as a drainageway, for public access, or other purposes. A usual condition of the easement is that the property owner may still develop and use the property as long as the easement's provisions are observed.

If the community did not fund the acquisition, it may still negotiate with the owner for an easement. The community may be able to offer a property tax break or even purchase the easement.

As noted in Chapter 4, a community needs to enforce the provisions of these easements to ensure that they fulfill their purpose. As the years go by (particularly if flood problems do not recur), property owners tend to forget that there is an easement attached to the lot.

In conjunction with a stormwater management project (described in Chapter 8), the **Town of Hilton Head Island, South Carolina**, purchased a 55-acre tract on which it created a lake for water storage, preserved wetlands, and created a park. Responses to a questionnaire distributed to the Town's residents a few years before had identified the need for a park and revealed the kind of amenities that would be most used.

The park is designed as a passive recreation area with trails and picnic areas. Little vegetation was removed to construct the park infrastructure, and the walking trails were designed to go around trees, so that they would not have to be cut down. A boardwalk was constructed to leave the site in its natural condition and teach visitors about wetland mitigation through the interpretative signs along the trail. The undisturbed wetlands and the wetland mitigation area are protected permanently through restrictive covenants.

Sustainable Redevelopment

Ideally, the future use of a redeveloped flood-prone area should keep in mind key local concerns and couple them with long-term considerations of sustainability. This means that any redevelopment should take into account social, economic, and environmental factors and also look to the future to be sure costs are not deferred to future generations. In the long run, this will make for a redevelopment effort that meets with a broader range of support, makes fewer adverse impacts on people or the environment, and pays for itself in terms of revenue or benefits.

The specific concerns will be somewhat different for each community, but any redevelopment of flood-prone property should strive for as many of these characteristics as possible:

- Be economically viable;
- Offer amenities to the neighborhood or community;
- Allow for natural movement and/or temporary storage of flood waters; and
- Yield benefits to the ecosystem, such as protection of vegetation or habitat.

New Buildings for Redevelopment

In general, it is best to avoid having buildings in flood-prone areas. However, in many instances of localized flooding, the water is likely to be shallow and slow moving, and measures can be taken to avoid the risk of flood damage. It may be feasible and desirable to allow new construction in order to redevelop the flood-prone area to meet community needs. Particularly if drainage modification (as described in Chapter 8) can alleviate the flood problem, carefully putting the property to a new use can result in a revitalized neighborhood that can include new buildings and other community benefits.

If new buildings are allowed in a cleared area, it is essential that they be protected from flooding. A good rule of thumb is to require any new buildings to meet the floodplain management standards required for the SFHA (as specified in the community's ordinance) even though the area to be developed lies outside the SFHA. It is especially important to avoid placing structures in the portion of the area needed to convey the flood flow.

At the same time, a community needs to consider carefully what type of development and activities are appropriate for a given flood-prone area. Before specific redevelopment decisions are made, relevant ordinances, regulations, and land use plans that affect the neighborhood should be reviewed. Note that properties acquired with funds from FEMA and many other State and Federal programs restrict future use of the land to open space or similar uses that limit the redevelopment options.

Some background work may already have been done toward the decision. Has the area been targeted for special area preservation? Urban renewal? Is there a long-term transportation plan that will affect the neighborhood? What other restrictions are there on the property's use?

With advice, encouragement, and a periodic reminder about flooding, a private property owner may redevelop the area for a new use on his or her own. In a commercial area, sometimes redevelopment with flood protection measures can be economically worthwhile. However, the businesses will have to understand that they may be closed sometimes when the streets are flooded and access is cut off.

Some ideas for new construction in a redeveloped localized flood problem area are:

- Minimize buildings in the most flood-prone area and avoid any area needed for conveyance of flow. Use the lowest land for open space, streets, parking, or storage basins (as illustrated on page 4-11).
- Instead of single-family homes throughout the area, build townhouses or cluster the development on the safest ground.

For the community, redeveloping in this manner can reduce losses caused by a localized flooding problem, reduce public expenditures by keeping the land privately owned, and bring revenue from property taxes.

Reusing the Buildings

In some cases, buildings in areas subject to localized flooding can continue to be used, even if they have been damaged. Although repeated flooding tends to cause a structure to deteriorate, certain building materials and types of structures withstand the effects of flood water better, particularly if, as in the case of most localized flood problems, the water does not get very deep and recedes fairly quickly.

Reusing the building has the two obvious advantages of avoiding the expense and trouble of moving or demolishing it and of continuing to obtain economic benefit from the building, especially in the case of a commercial property. This could be important to a business that has a substantial investment in the structure or that may lose customers if it moves to a new location.

If the localized flood problem can be at least partially relieved by a drainage modification project (Chapter 8), then there is even more likelihood that a use for the building can be maintained. An extra precaution on the part of the owner would be to make alterations to the building (Chapter 10) or to the parcel to foster proper drainage and infiltration of stormwater so that the building's continued presence and use does not contribute to drainage problems in the future.

Another option is to put flood-prone buildings to a different use, one that is less susceptible to flood damage. It is easy to see that a supermarket would be vulnerable in a flood-prone area, while a farm equipment dealer's inventory would be less prone to damage from shallow flooding. Retrofitting the building (see Chapter 10) can make this an even more viable alternative. This has the advantage of preserving sales tax revenues for the locality and income for the landowner.

A community needs to consider whether any buildings in the target neighborhood have historical value. The local historical society or State historical preservation office can help make that determination. There may be opportunities to create a real community asset in a restored structure that is pertinent to local history (see page 5-7 for an example). Preservation societies and other nonprofit groups can be enlisted to assist with restoration plans and work.

After several floods damaged buildings in the Mississippi River floodplain, the **Village of Thebes, Illinois**, cleared out most of its floodplain. The village purchased one gas station on the edge of the flood-prone area. It was wet floodproofed and converted into a community building to serve the newly cleared park. The structure provided a meeting space, restrooms, and a garage for park maintenance equipment.

Funding was secured from several sources, including FEMA, the Community Development Block Grant, and the state Division of Water Resources.

Where to Get Help

- The Federal Emergency Management Agency has information about, technical expertise with, and funding programs for acquisition and relocation. See http://www.fema.gov.
- The U.S. Army Corps of Engineers has references on and experience with relocating houses. See http://www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm.
- Many organizations have Web sites with ample ideas, success stories, and links to possible funding sources:
  - American Planning Association at http://www.planning.org.
  - Association of State Floodplain Managers at http://www.floods.org.
  - American Greenways Program at http://www. conservationfund.org/?article=2471&back=true.
  - Land Trust Alliance at http://www.lta.org/.
  - The Nature Conservancy at http://nature.org/.
  - American Trails at http://www.americantrails.org/.
  - The Trust for Public Land at http://www.tpl.org/.
  - The Waterfront Center at http://www.waterfrontcenter.org/.

Additional resources are listed in Appendixes A and B.

Part IV

Site-Specific Tools and Techniques

Part IV of this guide narrows the focus to techniques that can be applied to one house at a time, and even by individual property owners, to reduce potential flood damage or better cope with it when it occurs. This part covers retrofitting and flood insurance.

Part IV:

Chapter 10. Retrofitting

Chapter 11. Flood Insurance

10

Retrofitting

This chapter outlines retrofitting techniques and some of the precautions that should be followed before they are implemented. Retrofitting a building is implemented by the building's owner, but the community also has an important role, which is discussed in the last section of this chapter.

Introduction

Retrofitting is defined as making changes to an existing structure to reduce or eliminate the possibility of flood damage. As a flood mitigation technique, retrofitting can have several advantages:

- It can be implemented on a building-by-building basis.
- It can be relatively inexpensive.
- It can be the most cost-effective approach for certain types of structures subject to shallow flooding.
- It can be implemented by the individual building owner; it does not have to wait for government funding.
- It can improve the market value of the property.
- Properly designed, it would not disrupt the neighborhood or natural streams.
- It retains the tax base and community integrity.

Retrofitting Techniques

This section presents six retrofitting techniques:

- Elevation;
- Barriers;
- Yard improvements;

- Dry floodproofing;
- Sewer backup protection; and
- Wet floodproofing.

They are listed in order from what is generally considered the most effective and dependable technique—elevation—to the least desirable—wet floodproofing. For each technique, this section will explain how the retrofitting method works, where it should and should not be used, and its advantages and disadvantages.

There are two other ways to mitigate flood damage to a building that are not covered in this chapter. The most effective way to permanently protect a building from flooding is to relocate it out of the floodplain, which is discussed in Chapter 9. The other way is called "emergency measures," which means waiting for the flood and then moving things out of the way. Emergency measures are temporary and are not considered a dependable mitigation approach. They are discussed under "Site-Specific Responses" in Chapter 6.

Elevation

If a building is to remain in place, elevating it to prevent flood waters from reaching vulnerable areas is considered the most effective retrofitting technique. The structure typically is raised so that the lowest floor is at or above the design flood elevation (DFE).

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This compact wood frame house on a crawlspace only had to be elevated 2 feet to be 1 foot above the 100-year flood level in this shallow, repetitively flooded area. The cost to the owner was under $10,000 in 1985.

Raising a building above the flood level on an open foundation (e.g., piles, piers, or posts) is an effective on-site property protection method. Water flows under the building, causing little or no damage to the structure or its contents.

Alternatives are to elevate on continuous foundation walls (creating an enclosed space below the building) or on compacted earthen fill. Although elevating on compacted fill is sometimes the most desirable elevation solution, it is a complicated alternative. The building has to be temporarily moved so the fill can be placed and properly compacted; the building is then moved back to the site. This process may make elevating on fill more costly than elevating on an open foundation or continuous foundation walls.

The ease with which an elevation project can be accomplished usually depends on the building's construction type. A large or rambling masonry building is more difficult to elevate than a smaller, compact wood-frame structure. The type of foundation is the most important factor—the contractor must use equipment to raise the building off its foundation. There are four types of foundations:

1. Crawlspace construction (easiest to elevate);
2. Piers, posts, and pile construction;
3. Basement construction; and
4. Slab-on-grade construction (hardest to elevate).

The design flood elevation, or DFE, is the specified level of protection to which a structure will be protected by the retrofitting project. Selecting the DFE is discussed on page 10-16.

One of the difficulties with elevation is that when newly created lower levels are used for storage, the stored items can be damaged by flooding. If the building is elevated 8 feet or more, the owner may be tempted to convert the lower area into a habitable living space, complete with carpet, insulation, and furniture, which can increase the cost of a flood and negate the benefits of the elevation project.

One way to help prevent conversions is to have the owner sign a nonconversion agreement. The owner and the Recorder of Deeds sign the form indicating that the restrictions on the enclosure have been recorded on the deed to the property. Since the deed follows the property, future homebuyers are informed of the restrictions.

Advantages of elevation

- Elevation is the most dependable way to protect the structure and contents; everything subject to damage is above the flood level.
- If the property is in the Special Flood Hazard Area (SFHA), elevation is the only way to bring a substantially improved or substantially damaged building into compliance with the National Flood Insurance Program (NFIP) regulations.
- Elevation can reduce flood insurance premiums.
- Elevation techniques are well known, and qualified contractors are often readily available.
- Elevation does not require the additional land that may be needed for floodwalls or levees.

Disadvantages of elevation

- Elevation can be expensive, especially for buildings on slab foundations.
- The appearance of the structure may be adversely affected.
- Stairs may be required to access the building.
- Elevation is not appropriate in areas with high-velocity water flow, fast-moving ice or debris flow, or erosion, unless special measures are taken.
- Some zoning ordinances and subdivision covenants prohibit buildings above a certain height.
- Owners may lose their basements.

French & Associates

The owner who built this low floodwall landscaped it with stones and grading to minimize its visual impact. The design depends on human intervention to close the driveway opening.

Barriers

When properly designed and constructed, local barriers, such as floodwalls and levees, can be effective devices for repelling flood waters. Both levees and floodwalls can hold back flood waters, but they differ in their design and construction, appearance, and application. Levees are embankments of compacted soil, and floodwalls are built of concrete, masonry, or steel.

The sides of a levee are sloped to provide stability and resist erosion, thus the width is usually 6 to 8 times its height. As a result, the taller the levee, the more space is required. Since a floodwall does not rely as much on its mass to resist flood forces, it requires less space than a levee of similar height.

A floodwall or levee can surround an entire structure or, depending on the flood levels, topography, and design preferences, it can protect isolated structure openings such as doors, windows, and basements. In some shallow flooding areas, this may be all that is needed to protect a vulnerable portion of the structure. An example is shown in the photos at the top of the facing page.

The costs of floodwalls and levees can vary greatly depending on the height, length, availability of construction materials, labor, access closures, and the interior drainage system. Maintenance of the barrier must also be performed on a scheduled basis to monitor and address settling or cracking that may occur over time. Other concerns are tree roots and burrowing animals that build tunnels through or under the levee or wall.

Marsha Hilmes Robinson

Marsha Hilmes Robinson

This house has a barrier around the stairwell that protects it from shallow and short-duration flooding. This barrier requires several precautions, explained later in this chapter: a structural investigation is needed to ensure the walls will withstand the water pressures, and warning time is needed to slide the board into place (an example of human intervention).

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Although this neighborhood is in an X Zone, these two typical homes have experienced repeated floods. Heavy local rains fill the streets with water once or twice a year. The water rises above the curbs and sidewalks and pours down the driveway to the sunken garages.

The owner on the left raised the driveway retaining wall, cut grooves in it, and placed a board in the grooves when rains threatened the house. The board has rubber gaskets and hangs on the wall in the background. The owner of the house on the right opted to raise the retaining walls and the sidewalk to act as a permanent barrier to street flooding.

The photo on the left was taken in the 1980s. Since that time, the owner has abandoned the approach that relies on human intervention and has also raised the sidewalk in front of his driveway.

Cost, complexity, and space requirements generally limit localized levees and floodwalls to a height of 6 feet. Keep in mind that levees, floodwalls, and any other measure, can always be overtopped by a flood higher than expected. Overtopping allows water into the protected area, and the resulting damage to the structure can be as great as if it had not been protected at all.

Another important design consideration is the effect that a levee or floodwall can have on other properties, because they divert water away from the protected structure. Such barriers must be kept out of the conveyance portion of the overbank area and back from required property line setbacks and drainage easements.

Advantages of barriers

- Barriers can protect multiple structures.
- Occupants usually do not have to leave the structure during construction.
- Barriers are usually less expensive than elevating or relocating the entire structure.
- Property inside the barrier will be protected from inundation without significant changes to the structure.

Disadvantages of barriers

- Barriers may require land to construct.
- They must be maintained to be reliable.
- Depending on the size, they can be very expensive.
- Barriers will not reduce flood insurance premiums.
- Overtopping or failure eliminates any protection provided.
- Barriers may have openings, thus human intervention may be required.
- They may restrict access to the structure.
- Interior drainage must be provided.

Yard Improvements

Shallow flooding can often be kept away from a structure if some simple improvements are made to the yard. Sometimes structures are built at the bottom of a hill or in a natural drainageway or storage area, so that water naturally flows toward them.

One solution is to regrade the yard. If water flows toward the building, a new swale or wall can direct the flow to the street or a drainageway. Filling and grading next to the building can also direct shallow flooding away. Although water may remain in the yard temporarily, it is kept away from the structure. When these types of drainage modifications are made, care must be taken not to adversely affect the drainage patterns of adjacent properties.

Often water flows to a low entry point, such as a basement stairwell or patio door. A low wall or regrading around this point can keep water away, as illustrated in the photos to the right. If the water level does not recede within a few hours, an internal drainage system with a pump may be needed to handle seepage.

A related common problem results from disruption of the local drainage system. In most cases, subdivisions are designed for surface water to flow away from the structure to the lot line. A 5- or 10-foot easement on the lot line is designed to keep the area open, so water can flow to the front yard and into a drainage ditch or storm sewer or to a drainage swale in the back yard (as discussed on page 8-16).

Over time, the swales along the lot lines or in the back yard may get filled in. Property owners build fences, garages, sheds, swimming pools, and other obstructions up to the lot line. The photos on page 2-7 illustrate this problem. These drainage problems can be fixed by removing the obstructions and restoring the swales so they will carry water away from the building.

Advantages of yard improvements

- They are very effective when dealing with shallow flooding.
- They are low cost. Many projects can be built by the owner.
- Removing one obstruction may reduce flooding on several lots.

Disadvantages of yard improvements

- Adjacent owners must cooperate and be instructed on the need not to build new obstructions.
- They will not affect flood insurance premiums.

Fairfax County Stormwater Management Division

This house in Fairfax County, Virginia, has a patio lower than the rest of the yard. Localized flooding flowed across the yard, onto the patio and into the house. The County helped the owner raise the stairwell and grade the site so water flows away from the house.

Dry Floodproofing

Dry floodproofing involves sealing the exterior of a building to prevent the entry of flood waters. Unlike a barrier, dry floodproofing relies on the structure to hold waters out. Dry floodproofing a building involves:

- Using sealants or plastic membranes to prevent seepage of flood water through the walls;
- Installing watertight shields over doors and windows; and
- Installing measures to prevent sewer backup.

Because most structures were not designed or built to withstand water pressures, dry floodproofing is appropriate only for structures that face low-level flooding. The general rule is that this measure should not be used if a flood could exceed 2 or 3 feet in depth, unless a thorough investigation is made by a structural engineer.

Because dry floodproofing depends on plastic membranes and sealants, there is always the threat of seepage during a flood. Therefore, it may not be reliable if flood waters recede slowly.

The rate of rise of flood waters and the amount of warning time for the site is also important, because dry floodproofing often relies on human intervention to put the shields and closures in place.

Advantages of dry floodproofing

- Dry floodproofing may be less expensive than other retrofitting methods.
- It does not require the extra space needed for barriers.
- It retains the structure in its present environment.
- Dry floodproofing can avoid significant changes in appearance.
- It can reduce flood insurance premiums for non-residential structures.

Disadvantages of dry floodproofing

- Dry floodproofing is not dependable for deep flooding, so it is usually not recommended for buildings with basements.
- It is not dependable for long-duration flooding.
- If design loads are exceeded, walls may collapse, floors may buckle, and the structure may even float, potentially resulting in more damage than would occur if the house were simply allowed to flood.

W.A. Wilson Consulting Services

This house on a slab was dry floodproofed. The first 1.5 feet of the brick walls were covered with plastic sheeting, which was covered with facing brick to protect it from debris impact and damage by sunlight. A steel gate with rubber gaskets provides access at the doorway.

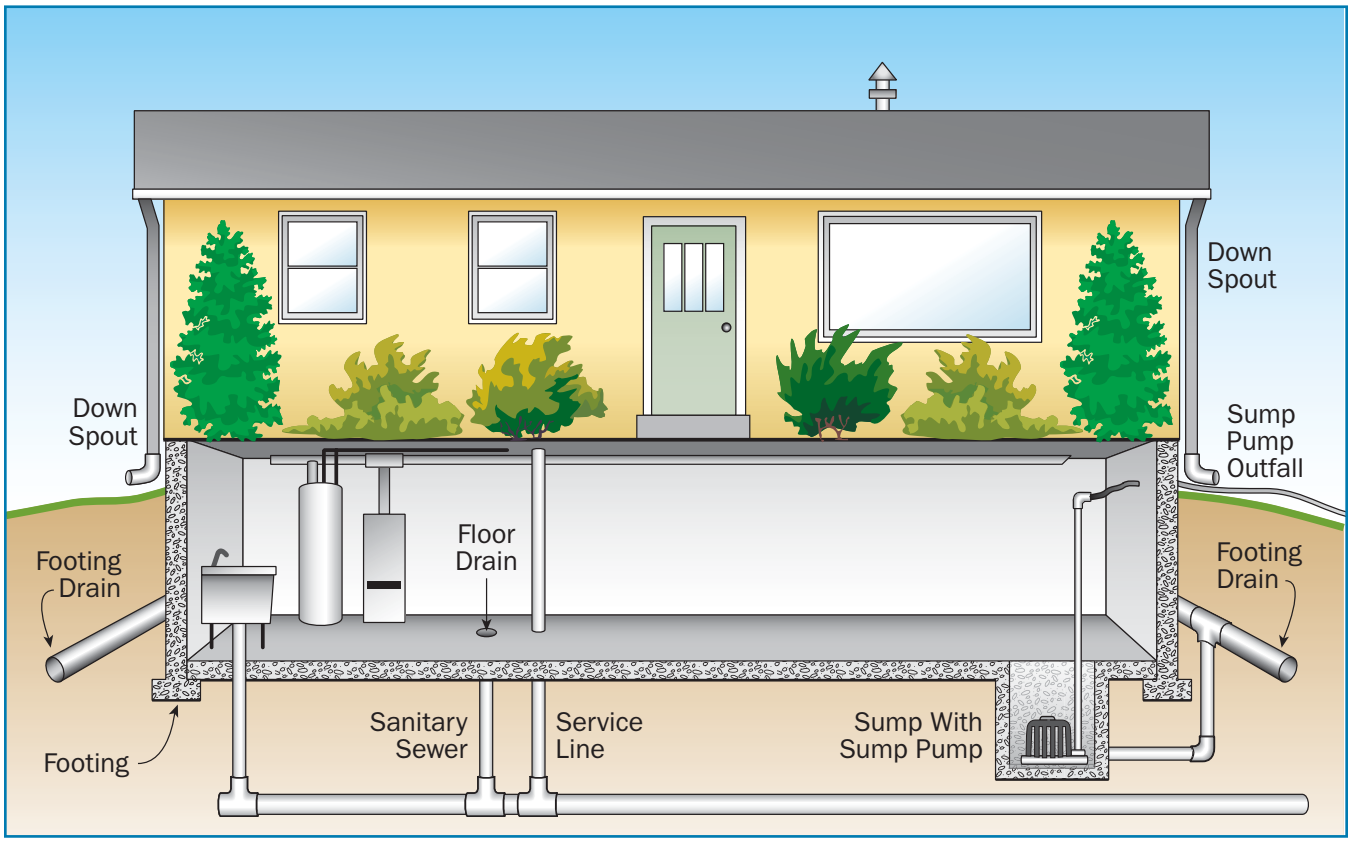
French & Associates

The original design for this apartment building had the air conditioner below the center window for each unit. After repetitive shallow floods poured through the air conditioners on the lowest floor, the owner hired an engineer. The engineer concluded that if the air conditioners were moved up and the hole sealed, the structure could withstand the water pressures that accompany flooding. The modification is an excellent example of dry floodproofing.

- Dry floodproofing may be subject to leakage, which could damage the structure and its contents.
- It usually requires human intervention and adequate warning time for installation of protective measures.
- Using this technique requires periodic maintenance.
- It will not reduce flood insurance premiums for residential structures.
- It does not protect a structure from the force of flowing water, erosion and scour, the impact of ice and other floodborne debris, or wave action.

Sewer Backup Protection

In many urban areas, sewer backup is the major cause of repetitive flooding. As illustrated below, a typical house has a sanitary sewer that drains toilet waste, laundry tubs, and, in some cases, the floor drain to the sanitary sewer main in the street. Clean stormwater and groundwater are handled by downspouts, footing drains, and sump pumps.



Typical basement drain and sewer arrangement.
Note: The floor drain may or may not be connected to the sanitary sewer line.

Sammy Says: Don't cause your own flood! Keep your sewer lines clear.

- Keep out roots from trees and shrubs with root killer.
- Make sure your yard clean-out vent will keep debris out.
- Don't pour dangerous liquids down the drain (motor oil, paint, pesticides, poisons, epoxies, etc.).
- Don't pour grease, fat, or cooking oil down the drain. They solidify later.
- Don't flush large solids, such as diapers, down the toilet.

Sewer backups can be caused by events not related to storms or flooding. Individual service lines can be plugged by grease, waste, tree roots, breaks in the pipe, or saturated ground. Proper maintenance can prevent most of these problems. This public information warning is from **Lansing, Illinois**, and is designed to encourage people to take steps to protect themselves from flooding. Lansing has a variety of materials displaying its flood protection mascot, Sammy Sandbag.

Often flooding is caused by these two sewer systems being interconnected. In older cities, some sanitary sewage and stormwater systems drain to a combined sewer system. In newer areas, some downspouts, footing drains, and sump pumps have been illegally connected to the sanitary sewer service. During a heavy rain, stormwater enters the sanitary sewers, overloading the main lines and causing the sewage to back up into basements and other low areas of buildings.

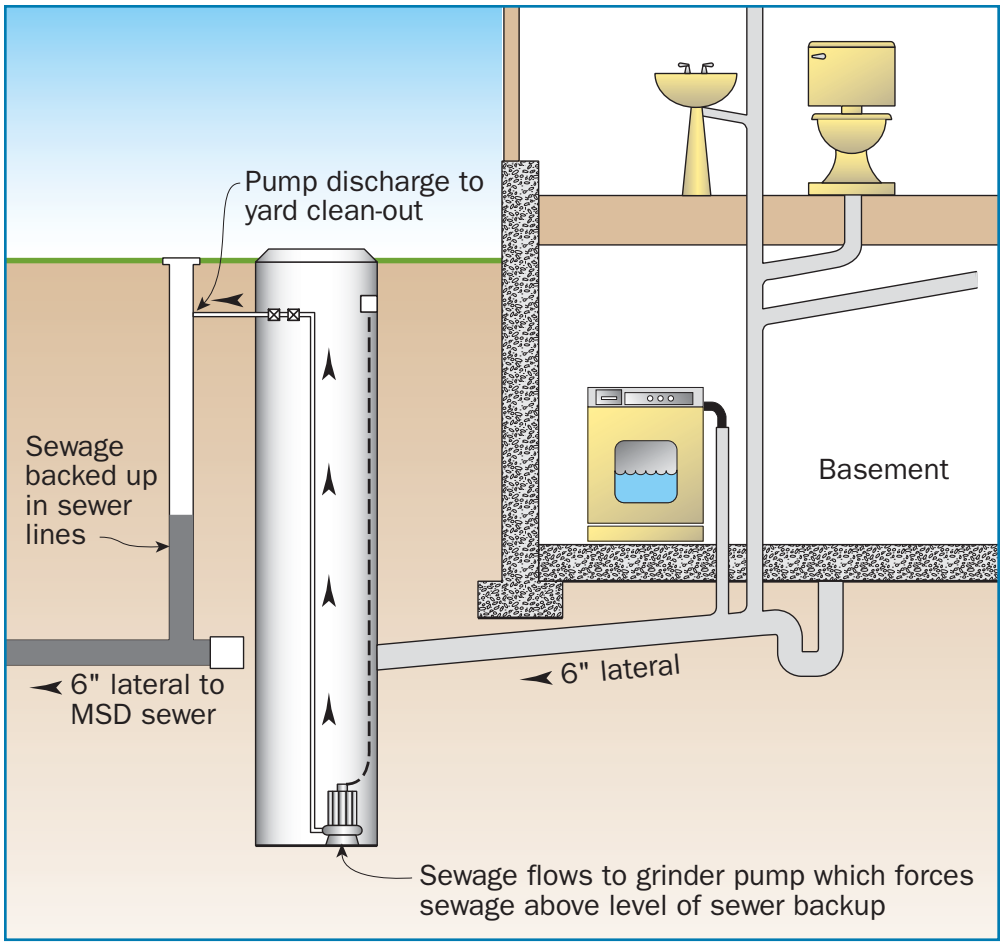
Floor drain float plug.

There are four main approaches to protect a structure against sewer backup: floor drain plugs, floor drain standpipes, backup valves, and overhead sewers. The first two devices keep water from flowing out of the lowest opening in the building, the floor drain. They typically cost less than $25; but if water becomes deep enough in the sewer system, it can flow out of the next-lowest opening in the basement, such as a toilet or laundry tub.

Backup valves and overhead sewer lines are more secure, but are also more expensive ($3,000–$5,000). A backwater protection valve allows sewage to flow out while preventing backups from flowing into the building.

An overhead sewer acts like a standpipe but without the shortcomings. A sump is installed under the basement floor to intercept sewage flowing from basement fixtures and the basement floor drain. An ejector pump in the sump pushes sewage up above the flood level. From there it can drain by gravity into the sewer service line. Plumbing fixtures on the first floor continue to drain by gravity to the service line.

In the unlikely event that the sewers back up above ground level, a check valve in the pipe from the ejector pump keeps it in the pipes. Backed-up sewage is enclosed in the sewer pipes and doesn't overflow laundry tubs or basement toilets. Hydrostatic pressure is kept in the pipes outside the building walls, so if a break were to occur, it would be easier to fix than if the pipe burst under the building.


Pump discharge to yard clean-out
Sewage backed up in sewer lines
Basement
6" lateral to MSD sewer
6" lateral
Sewage flows to grinder pump which forces sewage above level of sewer backup

Adapted from Metropolitan St. Louis Sewer District

Called a "grinder pump," this is a variation on the backup valve and overhead sewer. The Metropolitan St. Louis, Missouri, Sewer District has funded the installation of many such pumps to prevent sewer backup in its service area.

During a power outage, the ejector pump will not work unless a backup generator is provided. An outage would only limit the use of the facilities in the basement that need the pump. The upstairs plumbing would still work, and the sewer would still be prevented from backing up.

Advantages of sewer backup protection

- The floor drain plug and standpipe are inexpensive ways to prevent sewer backup.
- The automatic sewer backup valve and overhead sewer are almost 100-percent dependable and require no human intervention.

Disadvantages of sewer backup protection

- The floor drain plug and standpipe need to be removed to allow any spillage on the floor to drain. This requires someone to put it in place when it rains (human intervention).

- The floor drain plug and standpipe do not stop backup from coming out of the next-lowest opening, like a laundry tub or toilet.
- The floor drain plug and standpipe do not reduce the hydrostatic pressure on the sewer lines. If the line under the floor is not cast iron, it may break under pressure.
- Sewer backup can equalize hydrostatic pressures on the basement walls and floor, preventing them from collapsing due to outside water pressures. Therefore, although stopping stopping sewer backup keeps sewage out, it may also increase the risk of structural damage.
- The sewer backup valve and overhead sewer require periodic maintenance, something that is easy to forget because they are often placed out of sight.

Wet Floodproofing

Wet floodproofing is a term that covers various ways to protect a structure, its utilities, and its contents, while allowing flood waters to enter the structure. Wet floodproofing is the complement of dry floodproofing—the latter keeps water out, but at risk of damaging the structure from water pressures (see the photograph of the basement floor on the left). Wet floodproofing prevents such damage by letting the water in, so the pressures will be the same on both sides of the walls and floors.

French & Associates

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This basement floor in the photograph on the left buckled when the building was surrounded by flood waters. It is testament to the pressure water puts on a structure. If the basement had been wet floodproofed, the flood water allowed into the building would have equalized the pressures on the outside, and this damage would not have happened. The photograph on the right is an example of a wet floodproofed garage, i.e., an area that can be flooded with little or no damage to the structure or contents. Note the elevated water heater and unfinished walls. (In this case, gypsum wallboard is required under the local fire code.)

Wet floodproofing is usually one of the most cost-effective means of reducing exposure to flood damage. Virtually any activity to reduce the number of things exposed to water damage is a wet floodproofing measure. This can be as simple as picking the television set up and setting it on a table or rolling up the carpet in the basement and taking it upstairs. A tall water heater installed on the floor can be replaced by a shorter, fatter one on a pedestal (see the photograph).

All construction and finishing materials in the areas of the structure that can get wet must be resistant to damage caused by direct and possibly prolonged contact with flood waters. Since areas used for living space contain materials that are easily damaged by water, such as furniture, appliances, and carpeting, wet floodproofing is practical only for those portions of a structure that do not need to be finished. It is generally used on enclosures below elevated buildings, basements, crawlspaces, garages, and utilities and service equipment inside and outside the building.

Wet floodproofing requires human intervention in most cases. To reduce this need, the interior finishes

can be changed to improve their resistance to flood damage. Gypsum wallboard can be removed, and epoxy or other impervious paints can be applied to the walls and floors to reduce the likelihood of contaminants seeping into concrete. This will also make cleanup easier after the flood. See the various measures that were taken to wet floodproof the demonstration house in South Carolina shown on page 5-7.

Advantages of wet floodproofing

- Wet floodproofing reduces the potential of structural damage by minimizing flood forces on the structure due to standing water and buoyancy.
- Many wet floodproofing actions can be accomplished for a minimal cost.

Disadvantages of wet floodproofing

- Wet floodproofing usually requires human intervention and, therefore, warning time.
- It does not reduce the cost of flood insurance for residential structures.
- It is most effective when the building is constructed of flood-resistant materials, e.g., concrete or block floors and walls.
- The wet floodproofed area will be inundated by dirty floodwater and will need to be cleaned, sanitized, and dried out.

Precautions and Parameters

The retrofitting measures presented in the previous section will not work everywhere. There are certain technical precautions and design parameters that affect whether and how a measure should be used.

Precautions

There are some limitations to all retrofitting measures and some precautions that apply only to some of them. The following should be understood before the community or the property owner undertakes a project.

Safety. The property will still be subject to flooding after the building is retrofitted. It should not be occupied during a flood. Even if the structure is high and dry or protected by a barrier, entering or exiting the structure presents a safety hazard. Riding out the flood may sound safe, but the occupants should consider the possibility of an emergency and whether an ambulance can get to the building through the flooded streets.

Human intervention. Human intervention means that the retrofitting measure needs someone to take action in order for it to work. Examples include closing an opening, relocating contents, or turning on a pump. Other examples are seen on page 10-5 in the pair of photos at the top, and the bottom left photo. Projects that

do not need human intervention are illustrated on pages 10-2, 10-5 (bottom right photo), 10-7, and 10-8.

Retrofitting measures that require human intervention should be avoided. One reason elevation is the most desired retrofitting approach is because it does not need human intervention. During a flood, no one needs to do anything to make it work. Property owners can go to sleep at night or they can go on vacation without worrying about something that needs to be done during a thunderstorm.

Passive retrofitting that requires no human intervention is not, unfortunately, always possible. Building or funding constraints may dictate some human intervention in the design. Although not the most dependable approach, a measure that uses human intervention may be the most economical one and, if the required actions are taken when needed, it can be effective.

Work done by the owner. Some of the retrofitting measures, such as building a levee in the backyard and moving furniture upstairs, may be simple and straightforward enough for the owner to manage. However, some measures may not be as easy as they appear. A contractor, or even an architect or engineer, is recommended for the more complicated projects, such as elevation and dry floodproofing a structure. The community should also publicize where local codes require an engineer, a licensed plumber, or other professionals.

Level of protection. One of the most important steps in the process of retrofitting a structure is determining the level of protection. This process is more challenging for structures located in B, C, and X Zones where flood data are not available from the Flood Insurance Study or Flood Insurance Rate Map (FIRM). Ways to determine flood elevations are discussed in Chapter 4.

The specified elevation to which a structure is going to be protected through retrofitting (the DFE) is not necessarily the same as the regulatory flood elevation. If the property is located in a regulated floodplain (either the SFHA or a floodplain adopted in the community's ordinance) and the project will be a substantial improvement, then the design must comply with the regulations. In this case, the design protection level must be at or above the regulatory flood elevation.

However, if the project will not be a substantial improvement or it is not in a regulated floodplain, then the owner or designer is free to determine the DFE. Protecting to the 100-year flood level is highly recommended. However, there may be instances where protection to a lower level is more practical. An example would be a large masonry commercial structure on a slab foundation. The cost to elevate it could be hundreds of thousands of dollars, but the cost to dry floodproof the first 3 feet (the maximum height recommended) could be only $10,000 or $20,000.

It must be remembered that the DFE can always be exceeded by a higher flood. In general, the cost of retrofitting increases as the design protection level increases. In choosing the level of protection, the community and the owner must consider not only how much they are willing to pay, but also the level of risk they are willing to accept. Depending on the retrofitting technique and the level of protection, there will be some residual risk of flooding. No retrofitting technique completely eliminates that risk.

Other hazards. Although the focus of this chapter is retrofitting structures affected by flooding, the community and the owner should consider that retrofitting a structure influences how that structure reacts to other hazards. For example, an elevated building may be more at risk to wind damage or shaking from an earthquake.

Flood Insurance

In the SFHA, flood insurance rates for new buildings are based on the building's exposure to flooding by the base flood. Retrofitting a building outside the SFHA will not affect the owner's insurance premiums. If the building is in the SFHA, there are three instances in which the retrofitting project will affect flood insurance rates.

1. If a building in the SFHA is elevated above the base flood elevation, the owner can submit an Elevation Certificate to receive lower rates. The table shows how much lower the premium can be for an elevated building compared to the cost of insurance for an older (pre-FIRM) building that benefits from the subsidized rate.
2. If a non-residential building in the SFHA is dry floodproofed to or above the base flood elevation, the owner can submit the certificate needed to receive lower rates.
3. If the building is in the SFHA and the project is a substantial improvement, then the building must be protected to the base flood and the rates would be reduced accordingly.

Example NFIP Flood Insurance Premiums
(as of May 1, 2005)

Annual premium for $150,000 in building coverage and $60,000 in contents coverage for a one-story house with no basement and a $500 deductible. *Note that premiums are lower in CRS communities.*

Policy/Building Exposure	Premium
Outside the SFHA:	
Standard Flood Insurance Policy	$794
Within the SFHA:	
Pre-FIRM ("subsidized") rate	$1,372
Post-FIRM (actuarial) rates	
2 feet above base flood elevation	$400
1 foot above base flood elevation	$577
At base flood elevation	$924
1 foot below base flood elevation	$3,288

It can be seen that protecting a pre-FIRM structure (one built before the date of the original FIRM for the community) to a level 2 feet above the base flood can save the owner about $1,000 annually in reduced insurance premiums. However, if the project is a substantial improvement in the SFHA and the building is not protected to the base flood elevation, the owner may be required to pay over $3,000 annually in flood insurance premiums.

It should be remembered that even if the current owner does not want insurance (e.g., if he or she thinks that the project will protect the building from all floods), future owners may need to purchase a policy as a condition of a mortgage. The current owner has an incentive to make sure that a future owner can afford the required flood insurance.

Design Parameters

There are many different factors that affect whether a building should be retrofitted and what measure to use. Because of this, a building contractor and a design professional, such as an engineer or architect, would be helpful. The owner and the design professional need to consider important characteristics before a measure is selected and detailed plans are prepared. Many of these conditions vary greatly from one building to another, so gaining as much information about these characteristics as possible will help the design professional determine the most appropriate retrofitting techniques.

Building condition and type. A dilapidated structure may not be worth protecting. A foundation that has settled and cracked will present problems if the building is to be elevated or dry floodproofed. As noted above, certain types of buildings are easier to retrofit than others. Buildings on crawlspaces are the most cost-effective to elevate, but generally they cannot be dry floodproofed because the floor is not watertight.

For more about designing a retrofitting project, designers should consult *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings* (FEMA 259).

Design protection elevation. As stated earlier, the owner or designer has some flexibility in setting the DFE. If the protection level is less than 3 feet deep over the floor, dry floodproofing becomes feasible, although it may not result in protection to the base flood elevation.

If the owner would like Federal financial assistance to retrofit, he or she must show that the benefits of the project exceed the cost. This is done using a benefit-cost program that compares the long-term risk and potential for damage to the cost of the project. To do this, the program needs an accurate elevation of the lowest floor, which is compared to the elevation of the 10- and 100-year floods.

Therefore, if financial assistance is sought, it may be worthwhile to conduct a study to calculate the various flood elevations before selecting the DFE. (See also the discussion on setting a regulatory flood elevation in Chapter 4.)

Buildings in an SFHA that are being substantially improved (or have been substantially damaged) must be elevated to or above a DFE that is at least as high as the base flood elevation (BFE) and possibly higher, depending on the local ordinance. Even if the proposed modification is not a substantial improvement, it makes little sense not to elevate to at least the BFE even if it is not required. Usually it will not cost much more and will yield the added benefit of post-FIRM insurance rates, which are usually lower

than pre-FIRM rates. In localized flooding areas where there is no readily available BFE, other types of retrofitting could be designed to a DFE that may be lower than the BFE. Owners and designers should bear in mind the precautions and parameters noted above when selecting a DFE.

Hydrodynamic forces. Hydrodynamic forces include velocity and debris that can batter a structure. Higher velocities can cause erosion and scour a levee or the soil supporting the building. Debris can include trees, portions of flood-damaged buildings, mobile homes, storage tanks, and in cold climates, sheets or chunks of ice. The potential for debris to damage the structure is difficult to predict, but some data on velocities can be found in the Flood Insurance Study. If there are no studies, the forces can be estimated from previous floods.

In most localized flooding situations, velocity and debris are usually a minimal concern. However, the owner and designer need to consider special precautions if velocities exceed 5 feet per second or if there is a history of higher velocities or debris during previous local floods.

Warning time and rate of rise. How fast a flood rises determines whether human intervention measures are feasible. In areas of steep topography, in places with a high degree of urbanization and impervious surfaces, or in small drainage areas, floodwaters can rise very quickly with little or no warning. If there is a fast rate of rise but no public warning, measures dependent on human intervention should be avoided. (Flood warning systems are covered in Chapter 6.)

There are ways to close openings and turn on pumps without human intervention. Doorways can be kept closed rather than open, as is done with the gate shown on page 10-8. Pumps can be activated when a sensor gets wet. These passive measures work, but they can increase the cost of the project and add to the likelihood of problems when the flood comes.

Flood duration. Floods of long duration may hinder access to the structure, but more importantly for retrofitting, they may affect the amount of time the water is interacting with the structure. Long periods of inundation are more likely to cause significant damage than short ones. Certain retrofitting techniques, such as dry floodproofing, may be inappropriate in long-lasting flooding due to the increased chance of seepage, wicking, or other moisture damage caused by prolonged exposure to flood waters.

Regulations. Local building codes and floodplain regulations are critical parameters in the design of a retrofitting project. (Refer to Chapter 4 for a more detailed discussion of regulations.) Here are some common constraints that must be checked:

- Barriers are prohibited in the regulatory floodway and on drainage easements where they can divert flood waters onto other properties.
- If the project is a substantial improvement in the regulatory floodplain, a residential building will have to be elevated and a nonresidential building will have to be elevated or dry floodproofed.
- Zoning ordinances often have restrictions on the height of buildings, especially in residential areas. For example, the zoning ordinance may prohibit a house to be built more than 30 feet high. If a two-story house is

already 28 feet high, it would be difficult obtain a permit to elevate it much higher.

- Barriers may be prohibited if the regulations include a compensatory storage requirement or prohibit bringing new fill into the floodplain.
- Some building codes require that if an older building has electrical work, all the wiring and the service must be brought up to the current electrical code. While this is an excellent requirement, it adds more expense to a floodproofing project.

Regulatory standards that are not NFIP requirements may be amended by the community. It may be appropriate to modify a flood protection requirement in order to facilitate protecting a building from flooding. For example, some communities' compensatory storage requirements exempt floodwalls that are constructed within 10 feet of the building, thereby permitting a flood protection measure while minimizing the amount of lost flood storage.

Owner preference. A project to alter a building will not succeed without the support of the property owner(s). Owners should agree to a project only after they review these concerns and receive satisfactory answers:

- How much will the project cost?
- How will the construction project affect them?
- How secure will they be from future flood damage?
- What are their responsibilities in the project?

French & Associates

This library was built on flood-prone land donated by a developer. After flooding in 1986, 1987, 1989, and 1990, the library was relocated. The building was given to the fire department for a headquarters and training facility, and the village built this levee. The levee surrounds the building and has no openings requiring human intervention. The top is 2 feet above the 100-year flood.

- How will the project affect the appearance of their property?

It is important for the owners to understand that no project will provide total security from any future flood. A project can fail for a variety of reasons, such as:

- The flood exceeded the project's design level;
- The owners did not properly maintain the project after it was constructed; or
- The owners failed to take the appropriate actions during the flood, such as installing a closure, or they were away when the home flooded.

These last two items underscore the need for owners not just to agree to the project, but also to understand their long-term responsibilities to ensure that the measure will work when it's needed.

The owners' concern about how their homes and businesses will look after the project is completed is the most common reason for delays in projects, particularly elevation projects. There are many ways the designer can improve the appearance of the building, especially with landscaping. One example is the attractive floodwall on page 10-4.

The primary thing to remember about owners' preferences is that if the owners do not like the looks of a proposed project, the building may never be retrofitted. Similarly, if the owners are publicly displeased with the finished project, it may be hard to convince others of the merits of a similar retrofitting project.

Community Support

Usually, retrofitting measures are considered the responsibility of the property owner. However, local governments should have some involvement in all strategies that can reduce flood losses. Additionally, the community can play various roles in encouraging and supporting these projects. These opportunities are covered in more detail in the U.S. Army Corps of Engineers' *Local Flood Proofing Programs*.

Government Facilities

One of the first duties of a local government is to protect its own facilities. Fire stations, water treatment plants, and other critical facilities should be a high priority for retrofitting. This also sets an example and provides models for private property owners.

Public Information

The next step in supporting property protection measures is providing basic information to property owners. Owners need information about measures they can take, and they need to see examples, preferably from nearby neighborhoods or towns. Public information activities that can promote and support property

In Activities 330 and 350 (Outreach Projects and Flood Protection Information), the CRS provides credit for distributing technical information on property protection to citizens through newsletters, presentations, displays, library references, Web sites, and other means. Activity 360 (Flood Protection Assistance) encourages and provides credit for community visits to flood-prone properties and for giving the owner site-specific advice on retrofitting and other protection measures.

protection are discussed in Chapter 5. They are also eligible for credit under the Community Rating System.

Financial Assistance

The local government can be a pass-through and administrator for State or Federal funding programs, or it can contribute its own funds to allow for more locally appropriate arrangements. Financial assistance can range from full funding of a project to helping residents find money from other sources.

Some communities assume responsibility for situations that arise from an inadequate public sewer or drainage system—sewer backups, street flooding, and other problems. Rather than face loss of staff time, legal costs, and ill will over assigning blame, the Metropolitan St. Louis, Missouri, Sewer District fully funds the sewer backup prevention measures shown on page 10-11.

Two community-supported programs are low-interest loans and rebates. These approaches do not fully fund a protection project, but they decrease costs to the community treasury and increase the owner's commitment to the project. Often, small amounts of money act as a catalyst to pique the owner's interest and get a self-protection project underway (described in the box on the facing page).

The more common outside funding sources are listed below. Unfortunately, some are available only after a flood or disaster declaration.

- Three Federal Emergency Management Agency (FEMA) programs, discussed in the acquisition section in Chapter 9, fund retrofitting and acquisition projects: Pre-Disaster Mitigation, Flood Mitigation Assistance grants, and the Hazard Mitigation Grant Program.
- After a flood or other type of disaster that warrants a Presidential disaster declaration, damaged public and nonprofit properties can be eligible for funds that help pay for retrofitting measures that mitigate against future damage as part of funding repairs and reconstruction. However, the amount of assistance will be reduced by the amount of flood insurance that the public agency should be carrying on the property.
- A Presidential disaster declaration may also trigger funds for limited home repairs and unmet needs for disaster victims. Sometimes these programs include wet floodproofing measures, such as replacing a flooded furnace in the basement with a furnace at a higher, flood-free, level.
- Community Development Block Grants are provided to larger cities and counties; smaller communities can apply to the State community development agency.
- The U.S. Army Corps of Engineers will support elevation projects as part of a larger flood protection program. The Corps works with the community, not directly with the property owner.
- Flood insurance claims can include Increased Cost of Compliance (ICC) funding. This provision increases a flood insurance claim payment to help

underwrite a flood protection project required by code as a condition to rebuild the flooded building. It can also be used to help pay the non-Federal portion of a cost-shared retrofitting project.

- After a disaster declaration, the Small Business Administration may provide disaster loans for non-governmental properties. There is a provision for additional funds for retrofitting.

Property Protection Rebates

The Village of **South Holland, Illinois**, has a rebate program to help property owners fund retrofitting projects to protect against surface and subsurface flooding. If a project is approved, installed, and inspected, the Village will reimburse the owner 25% of the cost up to $2,500. About 650 floodproofing and sewer backup protection projects have been completed under this program. Perhaps not surprisingly, contractors have become some of the best agents to publicize this program.

Lexington-Fayette Urban County, Kentucky, has had a rebate program since 1992. It funds up to 50% of the cost of a project. It has distributed nearly $1,250,000 to protect 340 homes from surface flooding.

Where to Get Help

- Two helpful resources for making flood-resistant modifications to houses are *Homeowner's Guide to Retrofitting: Six Ways to Protect Your House from Flooding*, Federal Emergency Management Agency, FEMA 312, 1998, which is available at http://www.fema.gov/hazards/hurricanes/rfit.shtm and *Engineering Principles and Practices for Retrofitting Flood Prone Residential Buildings*, Federal Emergency Management Agency, FEMA 259, 1996.
- FEMA's retrofitting publications can be found at http://www.fema.gov/hazards/floods/whatshouldidoprotect.shtm.
- The Regional Office is the best place for information about FEMA mitigation funding.
- The Corps of Engineers' National Nonstructural/Flood Proofing Committee's Web site, http://www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm, lists retrofitting references. The Corps' District offices may be able to provide technical advice on retrofitting measures.
- The most extensive retrofitting Web site is Louisiana State University's (LSU) Extension Center, http://www.louisianafloods.org. In addition to listing LSU's many publications, the site offers advice on floodproofing and flood insurance, and a link to the national Extension Disaster Education Network. There are also links to online shopping for retrofitting products, contractors, and professional services, and to examples of installations.

Additional resources are listed in Appendixes A and B.

11 Flood Insurance

Flood insurance is essential in helping people repair, recover, rebuild, and even install some retrofitting measures. Flood insurance has many advantages, especially for people in areas prone to shallower, localized flooding problems.

- Homeowners, renters, businesses, and the local government can all purchase flood insurance, whether the property lies within the designated flood zones on the community's Flood Insurance Rate Map (FIRM) or lies outside of them, in an area subject only to localized flooding.
- Because localized flooding is unlikely to reach conditions severe enough for a Presidential disaster declaration, aid from the State or Federal government will be limited. In the absence of a disaster declaration, insurance may be the only source of assistance to help owners of damaged property pay for cleanup and repairs.
- Besides paying for flood damage, insurance payments can be used to cover part of the cost of mitigation measures required by the community's regulations (such as elevating the building above the base flood elevation). Increased Cost of Compliance (ICC) coverage of up to $30,000 may be provided (in addition to the claim payment for flood damage up to the limits of the policy) to elevate, floodproof, demolish, or relocate the property.
- Coverage is available for the contents of a home or business as well as for the structure.
- Renters can buy contents coverage, even if the building owner does not buy coverage for the structure itself.

NFIP Flood Insurance

Most standard homeowners insurance policies do not cover a property for damage caused by flooding. However, a business or homeowner can insure a building for damage by surface flooding through the National Flood Insurance Program (NFIP),

as long as the community in which the building is located participates in the program.

Flood insurance coverage is provided for buildings and their contents damaged by a "general condition of surface flooding" in the area. Flood insurance can be purchased for any eligible building in the community, even those outside the Special Flood Hazard Area (SFHA) shown on the community's FIRM. Residents in B, C, and X Zones can purchase coverage and can be eligible for the less-expensive Preferred Risk Policy discussed below.

Under the NFIP rules, a "building" is a walled and roofed structure that is mostly above-ground and fixed to a permanent foundation (even a manufactured home). "Flooding" is a general and temporary condition during which the surface of normally dry land is partially or completely inundated, affecting two properties or at least two acres in the area.

Community participation in the NFIP allows local insurance agents to sell a separate flood insurance policy under rules and rates set by the Federal Emergency Management Agency (FEMA). Any local property insurance agent may sell a policy through one of the "Write Your Own" insurance companies or a direct policy through FEMA. Both approaches result in the issuance of a Standard Flood Insurance Policy that meets all the requirements and nationally uniform rates determined by FEMA. Some sample premiums are shown in the table on the facing page.

Under the NFIP, building coverage is limited to $250,000 for residential dwellings and $500,000 for non-residential buildings. Contents coverage is available for up to $100,000 for a residence and $500,000 for a business.

Preferred Risk Policies. Preferred Risk Policies can be obtained for most residential or commercial buildings in B, C, or X Zones that have not had multiple flood insurance claims or disaster assistance payments. The policy offers different levels of building and contents coverage (contents-only coverage for renters) for a fixed premium. A sample rate is shown in the table on the facing page.

The Preferred Risk Policy has the same provisions as the Standard Flood Insurance Policy, and also includes the additional ICC coverage, as explained on page 11-6.

Claims. If an insured property is flooded, the property owner contacts his or her insurance agent. The agent arranges for an adjuster to review the damage and work with the insured to settle the claim. Property owners always work through their insurance agents; they do not deal directly with FEMA. Note that policy coverage details can change from year to year, and a purchaser should carefully read the policy when it is issued and renewed.

Building Coverage

For NFIP flood insurance, a building is defined as a walled and roofed structure. This includes manufactured homes, as long as they are principally above ground and affixed to a permanent site. Detached garages on a residential property are covered under the building coverage for up to 10% of the policy limits.

Example NFIP Flood Insurance Premiums
(as of May 1, 2005)

Annual premium for $150,000 in building coverage and $60,000 in contents coverage for a one-story house with no basement and a $500 deductible.

Note that premiums are lower in CRS communities.

Policy/Building Exposure	Premium
Outside the SFHA:	
Standard Flood Insurance Policy	$794
Preferred Risk Policy	$264
Within the SFHA:	
Pre-FIRM ("subsidized") rate	$1,372
Post-FIRM (actuarial) rates	
2 feet above base flood elevation	$400
1 foot above base flood elevation	$577
At base flood elevation	$924
1 foot below base flood elevation	$3,288

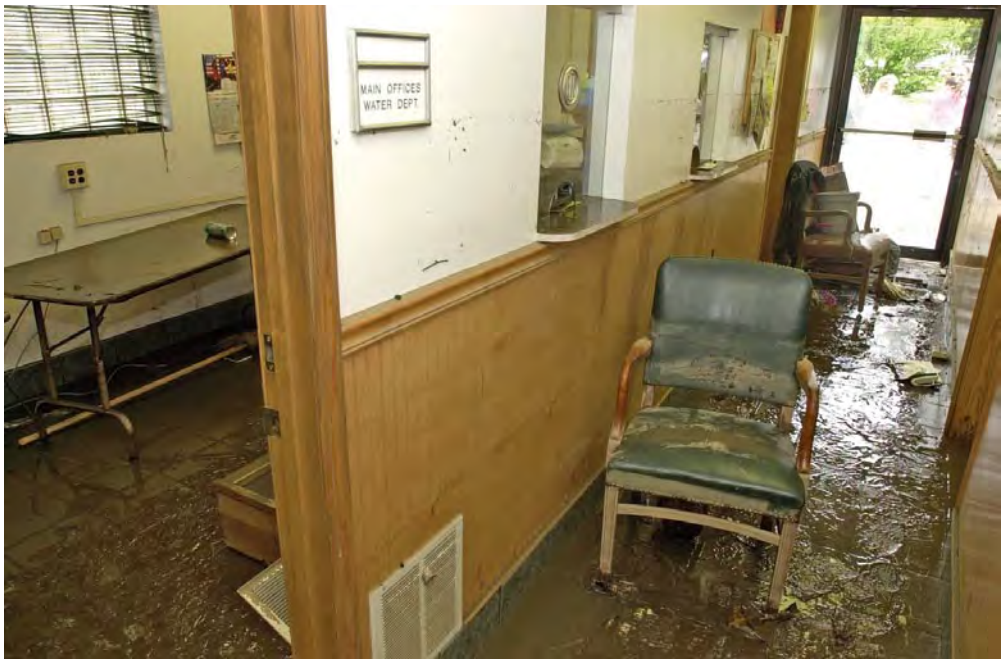
Building coverage is for the structure itself and all the things that usually stay with the building when it changes ownership, including:

- Utility equipment, such as a furnace, air conditioner, or water heater;
- Permanent flooring materials installed over unfinished flooring;
- Built-in appliances; and
- Wallpaper and paneling.

Coverage for items of property in a building enclosure below the elevated floor of an elevated post-FIRM building or in a basement is limited to a specific list of items described in the policy.

Contents Coverage

Contents coverage for flooding may be purchased separately from the building policy. If flood insurance is in force for a particular building because it was required by the lender when the mortgage was received, contents coverage may not have been purchased at that time, and the property owner should check to verify what coverage is in place. Insurance coverage is not required by most lenders for properties outside the SFHA, but some lenders do require it to protect their interest in the structure.



FEMA News Photo

Local flooding, with shallow, slow-moving floodwaters, damages carpeting, furniture, and other contents as much as it damages the structure. Contents coverage is highly recommended in areas subject to localized flooding.

Contents coverage is for the removable items inside the building, such as furniture, household items, and clothing. Renters can buy contents coverage, even if the owner does not buy structural coverage on the building.

Certain contents are not insurable or are subject to coverage limits, such as:

- Jewelry, artwork, furs, and similar items (coverage is limited to $2,500);
- Money or valuable papers;
- Animals and livestock; and
- Licensed vehicles.

Other Coverage

The standard NFIP policy also provides coverage for other expenses or damage related to a flood. These include certain costs associated with the removal of debris and measures taken to protect the property, such as sandbagging, purchasing pumps, and/or expenses related to removing insured items to safety.

Waiting Period

Policy owners should be aware that in most cases there is a 30-day waiting period after the purchase of an NFIP policy before it goes into effect. This rule encourages people to keep a policy in force at all times, rather than wait until there is a flood threat. A community should publicize the availability of flood insurance so residents can have their insurance protection in place by the time a flood comes.

About the Mandatory Purchase of Flood Insurance Requirement

The Flood Disaster Protection Act of 1973 and the National Flood Insurance Reform Act of 1994 made the purchase of flood insurance mandatory for federally backed mortgages on buildings located in SFHAs. It also affects all forms of Federal or federally related financial assistance for buildings located in SFHAs. The SFHA is the base (100-year) floodplain mapped on a FIRM. It is shown as one or more zones that begin with the letter "A" or "V."

The requirement applies to secured mortgage loans from financial institutions, such as commercial lenders, savings and loan associations, savings banks, and credit unions that are regulated, supervised, or insured by Federal agencies such as the Federal Deposit Insurance Corporation and the Office of Thrift Supervision. It also applies to all mortgage loans purchased by Fannie Mae or Freddie Mac in the secondary mortgage market.

Federal financial assistance programs affected by the laws include loans and grants from agencies such as the Department of Veterans Affairs, Farmers Home Administration, Federal Housing Administration, Small Business Administration, and the Department of Homeland Security's FEMA.

Lenders are required to complete a Standard Flood Hazard Determination (SFHD) form whenever they make, increase, extend, or renew a mortgage, home equity, home improvement, commercial, or farm credit loan to determine if the building or manufactured (mobile) home is in an SFHA. It is the Federal agency's or the lender's responsibility to check the current FIRM to determine if the building is in an SFHA. Lenders may read the FIRM themselves or they may use a flood zone determination company to provide the SFHD form.

If the building is in an SFHA, the Federal agency or lender is required by law to require the recipient to purchase a flood insurance policy on the building. Federal regulations require building coverage equal to the amount of the loan (excluding appraised value of the land) or the maximum amount of insurance available from the NFIP, whichever is less. The maximum amount available for a single-family residence is $250,000. Government-sponsored enterprises, such as Freddie Mac and Fannie Mae, have stricter requirements.

The mandatory purchase requirement does not affect loans or financial assistance for items that are not covered by a flood insurance policy, such as vehicles, business expenses, landscaping, and vacant lots. It does not affect loans for buildings that are not in an SFHA, even though a portion of the lot may be within the zone. While not mandated by law, a lender may require a flood insurance policy as a condition of a loan for a property in any zone on a FIRM.

If a person feels that an SFHD form incorrectly determines that the property is within the SFHA, he or she may request a Letter of Determination Review from FEMA. This must be submitted within 45 days of the determination. More information can be found at http://www.fema.gov/fhm/fq_gen11.shtm.

Note that even if a property is not in the SFHA or if FEMA issues a letter confirming that status, the lender may still require a flood insurance policy. Many areas of known local flooding are not in the SFHA, and having flood insurance is highly recommended. People in areas of local flooding should discuss building coverage, contents coverage, and Preferred Risk Policies with their insurance agents.

Mandatory Purchase Requirement

Although having a flood insurance policy is always a good idea, owners or renters of buildings subject to localized flooding that are outside the SFHA as shown on the community's FIRM are not required to have insurance as a condition of receiving Federal assistance, including federally backed mortgages. However, if the area is remapped and a building previously outside the SFHA becomes included within it,

the mandatory purchase requirement (see previous page) will be triggered if the mortgage is refinanced or the owner takes out a home improvement loan.

ICC Coverage

There is a special coverage provision in the NFIP for insured buildings that have been substantially or repetitively damaged by a flood. ICC coverage provides up to $30,000 to pay for the cost to comply with floodplain management regulations after a flood. If the building has been declared by the State or community to be substantially damaged or is repetitively damaged (as defined in the policy) the ICC coverage may be triggered. This payment is in addition to the damage claim payment that would be made under the regular flood insurance policy coverage. However, the total payments combined can not exceed the policy's amount of coverage.

Although a building subject to shallow localized flooding may be unlikely to be substantially damaged, it could become repetitively damaged by floods. In certain cases, an ICC claim can be paid if the building is repetitively flooded and has had two or more claims averaging 25 percent or more of the building's value within a 10-year period, provided the community requires that the property comply with its floodplain management ordinance.

ICC will pay up to $30,000 to help cover elevation, relocation, demolition, and (for nonresidential buildings) floodproofing. ICC is available for any flood insurance claim and, therefore, is not dependent on the community's receiving a disaster declaration.

Coverage under the ICC does have limitations:

- It covers only damage caused by a flood;
- The building's flood insurance policy must have been in effect during the flood;
- ICC payments are limited to $30,000 per structure; and
- Claims must be accompanied by a substantial or repetitive damage determination made by the local floodplain administrator.

A community that is serious about reducing its repetitive local flooding problems should learn the details of ICC coverage. Proper enforcement and an informed property owner can greatly facilitate the claims process and help fund mitigation measures for flood-prone buildings.

The Community's Role

NFIP flood insurance is available only in communities that participate in the NFIP. Communities must enforce their floodplain management regulations on new development in the SFHA (as discussed in Chapter 4) and stay in compliance with FEMA's rules and regulations. Failure to fully enforce these regulations could result in the community's residents having to pay a $50 probation surcharge or, if the community is suspended from the program, losing their flood insurance policies.

A community can help protect properties subject to localized flooding in the following ways:

- It can participate in the Community Rating System (CRS) to lower the cost of insurance for its residents and businesses. The CRS is discussed in Chapter 2.
- It can encourage its citizens and businesses to purchase flood insurance coverage. Local public information activities are discussed in Chapter 5.
- It should purchase insurance on its own public buildings.

A community that participates in the CRS earns reduced premiums for its residents who buy NFIP coverage, even those who are out of the designated SFHA. More than 1,000 communities across the United States now participate in the CRS. Their flood insurance policyholders outside the mapped SFHA receive reductions in their annual premiums of 5–10 percent, while policyholders in the SFHA receive reductions of up to 45 percent.

Under Activity 330 (Outreach Projects), CRS credit is provided to communities that carry out local public information and awareness programs that explain flood insurance to property owners.

Insurance for Public Property

If a local government's public buildings or facilities lie in any area that is prone to flooding, flood insurance should be obtained. Policies are available for public property through the NFIP, and local governments have other options as well.

A local government can set a good example for the rest of the community by obtaining flood insurance for its public buildings and facilities, even if they are not in the SFHA. Furthermore, a community with an array of public buildings both in and out of the floodplain should insure all of them. If a major flood occurs and many public buildings are damaged, the claims paid on the insured structures and contents will free up other local government funds that will be needed to repair and rebuild things that were not insurable. Furthermore, Federal disaster assistance will be reduced by the amount of insurance that the community should have had on its flood-prone buildings.

Larger local governments often self-insure against flooding simply by absorbing the cost of the damage. The expense of repair and rebuilding then comes out of the community's general fund. This avoids annual outlays in premium payments. However, if many properties or facilities are exposed to damage, self-insurance can be a major drain on the local treasury. Some communities essentially self-insure for part of the anticipated losses by specifying a higher deductible on their commercial property insurance policy, or by purchasing coverage on properties in flood-prone areas but not on others.

NFIP Insurance

Flood insurance is available under the NFIP for public buildings and contents anywhere in the community, just as it is for privately owned buildings. In general, there is an overall per-building limit for non-residential buildings of $500,000 for the structure and $500,000 for the contents.

Commercial Insurance Policies

Local governments can purchase commercial property insurance policies or join a local government insurance pool to protect their public buildings from perils such as flood, earthquake, and hail. Such policies have a couple of advantages:

Insurance Affects Disaster Assistance

It should be noted that Federal law expects public agencies to be fully insured as a condition of receiving Federal disaster assistance, and that such assistance will be reduced by the amount of insurance that the community should have had on its flood-prone buildings.

For example, if a city hall in the SFHA suffered $600,000 in flood damage to the structure, Federal disaster assistance will assume that the city had $500,000 in flood insurance coverage (the maximum coverage available under the NFIP for a non-residential building). The amount of disaster assistance would be 75 percent of the remaining $100,000. This would not affect public buildings outside the SFHA.

- The community can obtain more coverage than under the NFIP.
- The policy can be customized to meet the needs of the local situation, with special endorsements, varying deductibles, and other provisions.

Communities should verify the specific coverage and limitations of their policies. Many local agencies find out too late that their "all risk" insurance policies or government pools do not cover flooding. Further, many such policies have a deductible of $500,000, based on the assumption that the policy holder will get NFIP coverage for smaller flood losses.

Basements

There is limited coverage for basements under NFIP flood insurance policies. The NFIP defines "basement" as "any area of the building, including any sunken room or sunken portion of a room, having its floor below ground level (subgrade) on all sides." This includes the below-grade floors of bi-level and tri-level homes.

In general, flood damage to the walls and floor of the basement area is covered by the standard flood insurance policy; this usually is the most expensive damage to the basement. However, flood insurance coverage for basements is limited in two ways: (1) what is covered, and (2) when it is covered.

1. In the basement or subgrade levels of a house, NFIP flood insurance will cover damage only to specific items needed for the operation of the building, such as the furnace, water heater, electrical components, and sump pumps. If the policy has contents coverage, the following items are covered if they are located in a basement: clothes washer, dryer, food freezer, or portable air conditioning unit. There is no coverage for finishings such as wallpaper, carpeting, furniture, or other contents located in a basement.
2. Flood insurance covers basement damage only when there is a general condition of surface flooding in the area, and the flood is the proximate cause of the damage. Damage that occurs when water gets into the basement from some other cause, such as sump pump overflow or sewer backup not caused by a general condition of flooding, is excluded from coverage.

Sump Pump Failure

Many buildings in areas prone to localized flooding have sump pumps to automatically remove water that collects around the building foundation. Unfortunately, the pump may malfunction, or the electricity could go out, especially during a storm. NFIP flood insurance covers damage to the sump pump as a result of flooding, but does not cover water damage caused by sump pump failure (except in cases in which

there is general flooding in the area and that flooding is the proximate cause of the damage).

However, several private insurance companies offer coverage for water damage to a structure and its contents incurred if a sump pump fails. Each company has different amounts of coverage, exclusions, deductibles, and arrangements. Most such policies will not pay for damage from surface flooding that would be covered by the NFIP.

Sewer Backup

During heavy rains, stormwater may overload a community's sanitary or storm sewer system. If the water levels in the receiving streams are high, the storm sewers cannot drain. The water backs up, usually into basements and other low-lying areas (see Chapter 10 for more information and illustrations).

Flood Insurance Coverage for Basements

The NFIP has limited coverage for basements and the below-grade floors of bi-levels, split levels, split foyers, and other buildings that have their lowest floor below ground level. The NFIP defines "basement" as "any area of the building, including any sunken room or sunken portion of a room, having its floor below ground level (subgrade) on all sides." (Article II of the Standard Flood Insurance Policy, May 1, 2005.)

Coverage under building or structural coverage is limited to:

a. Any of the following items, if installed in their functioning locations and, if necessary for operation, connected to a power source:
   1. Central air conditioners;
   2. Cisterns and the water in them;
   3. Drywall for walls and ceilings in a basement and the cost of labor to nail it, unfinished and unfloated and not taped, to the framing;
   4. Electrical junction and circuit breaker boxes;
   5. Electrical outlets and switches;
   6. Elevators, dumbwaiters, and related equipment, except for related equipment installed below the base flood elevation after September 30, 1987;
   7. Fuel tanks and the fuel in them;
   8. Furnaces and hot water heaters;
   9. Heat pumps;
   10. Nonflammable insulation in a basement;
   11. Pumps and tanks used in solar energy systems;
   12. Stairways and staircases attached to the building, not separated from it by elevated walkways;
   13. Sump pumps;
   14. Water softeners and the chemicals in them, water filters, and faucets installed as an integral part of the plumbing system;
   15. Well water tanks and pumps;
   16. Required utility connections for any item in this list; and
   17. Footings, foundations, posts, pilings, piers, or other foundation walls and anchorage systems required to support a building.

b. Clean-up. (Article III. Section A.8.)

Coverage under personal property (contents) coverage is limited to the following items, if installed in their functioning locations and, if necessary for operation, connected to a power source:

a. Air conditioning units, portable or window type;
b. Clothes washers and dryers; and
c. Food freezers, other than walk-in, and food in any freezer. (Article III. Section B.3.)

Sewer backups can be costly, but sewer backup insurance is not!

All insurance companies writing homeowner policies in Virginia offer special coverage for damage resulting from backups of drains and sewers, and this additional protection is available at very reasonable rates. For information on obtaining sewer backup coverage, contact your insurance company.

The Town's insurance carrier rarely approves claims resulting from sewer backups unless negligence in maintaining the system can be shown. Therefore, residents are encouraged to protect their property by obtaining sewer backup insurance.

The Town of Vienna, Virginia, has this notice on its Web site, letting residents know about the availability of sewer backup insurance and also that claims against the Town are not likely to result in payments. The notice is accompanied by links to sites that offer advice about preventing damage from sewer backup.

http://www.ci.vienna.va.us/Town_Departments/backup_ins.htm

Policies under the NFIP can cover damage from sewer backup (even in the basement) if there are also general flood conditions in the area that caused the house and/or basement to get wet. If there is not a general condition of flooding in the area, an NFIP policy will not cover this damage. As noted on the previous page, there is still limited NFIP coverage for certain items in a basement, regardless of the cause of the flood.

However, several private insurance companies offer coverage for damage to a structure and its contents when sewer lines or a septic tank back up. Policy details will vary from company to company, but most of them will not pay for damage from surface flooding that would be covered by the NFIP. Each company has different amounts of coverage, exclusions, deductibles, and arrangements. Some endorsements on a homeowner's insurance policy are free; on others, the costs can range up to about $75.

Where to Get Help

- Local insurance agents have information on both the National Flood Insurance Program and private insurance for sump pump failure, sewer backup, and other related coverage.
- The State NFIP Coordinator can provide contacts for insurance and for the Community Rating System.
- The community's risk manager or finance office can provide information on whether community properties are adequately insured.
- The NFIP may be contacted directly at 1-800-CALL-FLOOD. This number can also refer callers to agents in the area who sell flood insurance.
- The NFIP Web site at http://www.fema.gov/nfip/ has useful information, answers to questions, lists of insurance agents, links to and order forms for publications, and public information materials.
- Information on the NFIP Preferred Risk Policy for residential buildings can be found at http://www.fema.gov/nfip/prphome.shtm and for businesses at http://www.fema.gov/nfip/prpbus.shtm.
- The CRS Resource Center Web site has a collection of CRS materials, publications, and links to other insurance-related information at http://training.fema.gov/emiweb/CRS/.

Additional resources are listed in Appendixes A and B.

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Morris, Marya. 1997. *Subdivision design in flood hazard areas.* Planning Advisory Service Report No. 473. Chicago: American Planning Association and Federal Emergency Management Agency. Copies can be ordered for $32 from American Planning Association, 122 So. Michigan Ave., Suite 1600, Chicago, IL 60603, (312) 431-9100. pasreports@planning.org.

National Flood Insurance Program. 2003. "Is the CRS worth it? Illinois officials respond." *NFIP/CRS Update* (Fall): 5-6.

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U.S. Department of Homeland Security/FEMA. 2002. *Promoting mitigation in Louisiana.* Washington, D.C.: DHS/FEMA.

Wetmore, French and Gil Jamieson. 1999. "Flood mitigation planning: the CRS approach." *Natural Hazards Informer 1* (July).

Appendix A Sources of Assistance

This is a list of contact information for the principal agencies and organizations that have expertise, information, and written materials about the techniques and tools for dealing with local flood problems as discussed in this guide.

Department of Homeland Security/Federal Emergency Management Agency
http://www.fema.gov

- Benefit-Cost helpline
  1-866-222-3580
- The Community Rating System
  http://training.fema.gov/emiweb/CRS/
- Cooperating Technical Partners Program
  http://www.fema.gov/fhm/ctp_main.shtm
- FEMA Regional Offices
  http://www.fema.gov/regions/
- FEMA For Kids
  http://www.fema.gov/kids
- National Flood Insurance Program
  1-800-CALL-FLOOD
  http://www.fema.gov/nfip/
- Planning Resource Page
  http://www.fema.gov/fima/planning.shtm
- Preparing for flooding
  http://www.fema.gov/hazards/floods/floodf.shtm
- Retrofitting publications
  http://www.fema.gov/hazards/floods/whatshouldidoprotect.shtm
- Training courses
  http://training.fema.gov/emiweb/

National Weather Service
http://www.noaa.gov or http://hydrology.nws.noaa.gov

- StormReady program
  http://www.stormready.noaa.gov
- Turn Around Don't Drown™ campaign
  http://www.nws.noaa.gov/om/water/turnaround.shtml

Rivers, Trails, and Conservation Assistance Program, National Park Service
http://www.nps.gov/rtca/

- List of funding sources
  http://www.nps.gov/ncrc/programs/rtca/helpfultools/ht_funding.html

Small Business Administration
http://www.sba.gov

State emergency management agency hazard mitigation offices
http://www.fema.gov/fema/statedr.shtm

State National Flood Insurance Program Coordinating Offices Directory
http://www.floods.org/StatePOCs/map.asp

U.S. Army Corps of Engineers
http://www.usace.army.mil

- National Nonstructural/Flood Proofing Committee
  http://www.usace.army.mil/inet/functions/cw/cecwp/NFPC/nfpc.htm

U.S. Department of Agriculture

- Agricultural Extension Services
  http://www.csrees.usda.gov
- Natural Resources Conservation Service
  http://www.nrcs.usda.gov or http://www.nrcs.usda.gov/programs/watershed

U.S. Department of Energy

- Smart Communities Network
  http://www.sustainable.doe.gov/disaster/disintro.shtml

U.S. Environmental Protection Agency
http://www.epa.gov

- National Pollutant Discharge Elimination System program
  http://cfpub.epa.gov/npdes/
- Environmental Kids Club
  http://www.epa.gov/kids/

U.S. Geological Survey
http://www.usgs.gov

Organizations

American Greenways Program
http://www.conservationfund.org/?article=2471&back=true

American Planning Association
http://www.planning.org

American Rivers
http://www.americanrivers.org

American Society of Civil Engineers
http://www.asce.org

American Red Cross
http://www.redcross.org

American Trails
http://www.americantrails.org/

Association of State Floodplain Managers
http://www.floods.org

National Association of Flood and Stormwater Management Agencies
http://www.floods.org/StatePOCs/stchoff.asp

- Certified Floodplain Manager Program
  http://www.floods.org/Certification/certprog.asp
- Mitigation Success Stories
  http://www.floods.org/Publications/mit%20succ%20stories/mssiii1.htm

Land Trust Alliance
http://www.lta.org/

National Association of Flood and Stormwater Management Agencies
http://www.nafsma.org

National Wildlife Federation
http://www.nwf.org

- Kidzone
  http://www.nwf.org/kids/

Nature Conservancy
http://nature.org/

The Trust for Public Land
http://www.tpl.org/

- Financing alternatives
  http://www.tpl.org

The Waterfront Center
http://www.waterfrontcenter.org/

State and Local Entities

- Local planning office
- Local emergency services office
- Local building department
- Regional planning commissions and councils of government
- Soil and water conservation districts
- State office of emergency management
- County emergency manager
- Local chapter of the American Red Cross
- Utility company and cooperatives
- School district
- Park department
- Youth groups

Appendix B Reference Works and Recommended Reading

The following are citations to all documents recommended in the text of this guide, supplemented by other materials useful in approaching local flood problems. It is organized by topic. Some references are listed under more than one topic.

Community-Level Approaches

Association of State Floodplain Managers. 1987. *Reducing losses in high risk flood hazard areas: a guidebook for local officials.* FEMA 116. Washington, D.C.: Federal Emergency Management Agency.

Association of State Floodplain Managers and U.S. Environmental Protection Agency. 1996. *Using multi-objective management to reduce flood losses in your watershed.* Madison, WI: ASFPM. This publication reviews the 10-step planning process and coordination of a hazard mitigation plan with other community goals and objectives. It includes examples, references, and lists of sources of assistance. It is particularly detailed on integrating flood protection activities with other community activities. To order, call ASFPM: 608-274-0123.

Association of State Floodplain Managers. 2001. *Flood mitigation planning—the first steps.* Madison, WI: ASFPM. This floodplain management planning kit consists of reference materials, masters for handouts, and a 2-part video that explains the 10-step process to the general public. It is designed to be shown at the first meeting of a planning committee. Order through the ASFPM Web site, http://www.floods.org or call 608-274-0123.

Association of State Floodplain Managers. 2003. *No adverse impact: a toolbox for common sense floodplain management.* Madison, WI: ASFPM. Available from World Wide Web: (http://www.floods.org).

Federal Emergency Management Agency. 2000. *Planning for a sustainable future: the link between hazard mitigation and livability.* FEMA 364. Washington, D.C.: FEMA. Available from World Wide Web: (http://www.fema.gov/fima/planresource.shtm). A 40-page illustrated overview of hazard mitigation principles, including a list of Federal technical assistance and funding sources.

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2003. *Example plans.* Washington. D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources." This 60-page document reviews the 10-step CRS credit criteria for floodplain management plans and identifies additional actions needed to also qualify as a FEMA-approved hazard mitigation plan.

Federal Emergency Management Agency. "How-to" guides for mitigation planning, available from World Wide Web: http://www.fema.gov/fima/resources.shtm.

Getting started: building support for mitigation planning (FEMA 386-1)

Understanding your risks: identifying hazards and estimating losses (FEMA 386-2)

Developing a mitigation plan: identifying mitigation actions and implementation strategies (FEMA 386-3)

Bringing the plan to life: implementing the hazard mitigation plan (FEMA 386-4)

Incorporating historic resources into mitigation planning (FEMA 386-6)

Integrating manmade hazards into mitigation planning (FEMA 386-7)

Federal Interagency Floodplain Management Task Force. 1996. *Protecting floodplain resources: a guidebook for communities.* FEMA 268. Washington, D.C.: Federal Emergency Management Agency.

Wright, J.M., and J.L. Monday. 1996. *Addressing your community's flood problems: A guide for elected officials.* Madison, WI: Association of State Floodplain Managers, and the Federal Emergency Management Agency. This 38-page booklet provides a useful explanation of the importance of planning, along with recommendations and first person testimonials. It is excellent background reading for elected officials. To order, call ASFPM: 608-274-0123.

Wetmore, French and Gil Jamieson. 1999. "Flood mitigation planning: the CRS approach." *Natural Hazards Informer 1* (July).

Regulatory Tools

Arendt, Randall G. 1996. *Conservation design for subdivisions.* Washington, D.C.: Island Press.

Association of State Floodplain Managers. 1987. *Reducing losses in high risk flood hazard areas: a guidebook for local officials.* FEMA 116. Washington, D.C.: Federal Emergency Management Agency.

Association of State Floodplain Managers. 2003. *No adverse impact: a toolbox for common sense floodplain management.* Madison, WI: ASFPM. Available from World Wide Web: (http://www.floods.org).

Federal Emergency Management Agency. 1995. *Managing floodplain development in approximate zone A areas: a guide for obtaining and developing base (100-year) flood elevations.* FEMA 265. 1995. Available from World Wide Web: (http://www.fema.gov). Includes the computer program QUICK-2: Computation of Water Surface Elevations in Open Channels, Version 1.0.

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2002. *CRS credit for stormwater management.* Washington, D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources."

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2002. *CRS credit for higher regulatory standards.* Washington, D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources."

Federal Emergency Management Agency. 2003. *Guidelines and specifications for flood hazard mapping partners.* Washington, D.C.: FEMA. Available from World Wide Web: (http://www.fema.gov).

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Morris, Marya. 1997. *Subdivision design in flood hazard areas.* Planning Advisory Service Report No. 473. Chicago: American Planning Association and Federal Emergency Management Agency. Copies can be ordered for $32 from American Planning Association, 122 South Michigan Ave., Suite 1600, Chicago, IL 60603, 312-431-9100. pasreports@planning.org.

Public Information and Awareness

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2002. *CRS credit for outreach projects.* Washington, D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources."

Warnings and Emergency Services

Denver Office of Emergency Management, Urban Drainage and Flood Control District. 2003. *Flood Protection Handbook.* Denver, CO: City and County of Denver.

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2002. *CRS credit for flood warning programs.* Washington, D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources."

National Science and Technology Council, Committee on Environment and Natural Resources. 2000. *Effective disaster warnings, report by the Working Group on Natural Disaster Information Systems Subcommittee on Natural Disaster Reduction.* Washington, D.C.: NSTC.

U.S. Army Corps of Engineers. 1985. *Guidelines on community local flood warning and response systems.* Washington, D.C.: National Technical Information Service.

Area Analysis

Federal Emergency Management Agency. 2001. *Understanding your risks: identifying hazards and estimating losses.* FEMA 386-2. Washington, D.C.: FEMA.

Federal Emergency Management Agency. 2003. "Mitigation BCA toolkit." Washington, D.C.: FEMA. This compact disk has FEMA benefit-cost analysis software, guidance documents, and case studies.

Federal Emergency Management Agency. 2005. "National Mitigation Data Collection Tool." Washington, D.C.: FEMA. This software is an aid to choosing appropriate mitigation measures for a flood-prone property, with information on risk, building construction, and costs. Available from NFIPCRS@iso.com.

Drainage Improvements

Association of State Floodplain Managers. 2003. *No adverse impact: a toolbox for common sense floodplain management.* Madison, WI: ASFPM. Available from World Wide Web: (http://www.floods.org).

Bannerman, Roger. 2003. *Rain gardens: a how-to manual for homeowners.* Madison: Wisconsin Department of Natural Resources.

Federal Emergency Management Agency. National Flood Insurance Program/ Community Rating System. 2002. *CRS credit for drainage system maintenance.* Washington, D.C.: FEMA. Available from World Wide Web: (http://training.fema.gov/emiweb/CRS/index.htm). Click on "Resources."

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Redevelopment

Federal Emergency Management Agency. 1998. *Property acquisition handbook for local communities.* FEMA 317. Washington, D.C.: FEMA.

Federal Emergency Management Agency. 2000. *Planning for a sustainable future: the link between hazard mitigation and livability.* FEMA 364. Washington, D.C.: FEMA. Available from World Wide Web: (http://www.fema.gov/fima/planresource.shtm). A 40-page illustrated overview of hazard mitigation principles, including a list of Federal technical assistance and funding sources.

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Federal Emergency Management Agency. 1996. *Engineering principles and practices for retrofitting flood-prone residential buildings.* FEMA 259. Washington, D.C.: FEMA.

Federal Emergency Management Agency. 1998. *Homeowner's guide to retrofitting: six ways to protect your house from flooding.* FEMA 312. Washington, D.C.: FEMA. Available from World Wide Web: (http://www.fema.gov/pdf/hazards/hurricanes/guide.pdf).

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Federal Insurance Administration. 1993. *Non-residential floodproofing—requirements and certification.* FIA-TB-3. Washington, D.C.: Federal Emergency Management Agency.

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